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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Chemistry in Agriculture

THE application of chemistry to agriculture is as old as agriculture itself, though, until quite recently, it was not the chemistry of the laboratory. From the earliest to the final stages the processes of vegetable growth have always involved the most subtle chemical changes and combinations, and it is astonishing how successful the unlearned husbandman has been in directing highly scientific developments, the science of which, in the strict sense, he never pretended to understand. The organisation of chemical services for the applied study of the problems involved in agriculture is a comparatively modern movement. We believe the first Government grant in aid of agricultural education was made some thirty years ago to the Bangor University College, when Professor (now Sir James) Dobbie was organising internal and external courses of instruction in the principles of manuring, feeding stuffs, dairy work, and the like. What was then a rather novel experiment is now the almost

universal practice. The stores of practical learning which one generation of yeomen passed on to the next have latterly been supplemented by exact and intensive scientific study, with great advantage in the increase of fertility and the limitation of disease and pests.

In this issue we deal with the subject of artificial fertilisers from the point of view mainly of supplies and manufacture, and the range of the contributions indicates the large part which such substances as sulphate of ammonia, potash, basic slag, lime, &c., now play in the replacement of exhausted fertility. The natural manures produced on the land itself are still recognised as the most complete, since they largely return to the soil what is taken out of it, but the advantage of the artificial article is that it can be used to correct an excess or make good a deficiency and thus to keep the various crops supplied with just the right kind and proportions of nourishment they need. Farmers are more and more learning the advantages accruing from their judicious use, and consumption during recent years has enormously increased. The question of adequate and cheap supplies of artificial fertilisers is, therefore, one of national interest and it is dealt with by various well-known writers from their own points of view in this issue.

The Future of Nitrogenous Fertilisers

It is interesting to cast back the mind to the period of the war and to recall the fears which many of the producers of nitrogenous fertilisers then entertained as regards the flooding of the market with synthetic products when once military requirements had ceased. In the menace of atmospheric nitrogen one finds another admirable example of the stimulation which rivalry so frequently begets. In this country we have, perhaps, earned a reputation for neglecting to appreciate, until almost too late, the full significance of newer developments; but in so far as home-produced fertilisers are concerned the situation was taken in hand in good time and with results which are a testimony to the policy of quick action.

The popular nitrogenous fertilisers over here are Chilean nitrate and sulphate of ammonia recovered from the distillation of coal. The latter is of particular importance, for, being a prominent subsidiary product, its utilisation has a considerable bearing on the commercial welfare of some of our staple industries. If, through the influence of competition, by-product ammonia became almost unsaleable, or prices dropped to levels such as to render its manufacture scarcely profitable, the effect would certainly be felt in the increased price of some of our everyday commodities, while it would necessarily be reflected on the market of other products such as sulphuric acid. For the moment, however, it would seem that there is no cause for alarm in this respect, for the propaganda of the British Sulphate of Ammonia Federation has

successfully popularised the fertiliser with the result that—apart from cyanamide—none of the synthetic products has yet entered the lists. There appears, in fact, to be a definite tendency on the part of consumers to transfer their customs from nitrate of soda to sulphate of ammonia, for, although the quantity of fertiliser employed per acre in this country must now be measureably greater than in pre-war days, this fact alone can scarcely account for the British farmer having employed more than four times the quantity of sulphate which sufficed for his purpose in 1913. Synthetic products must, of course, eventually come into the home market in large quantities, and the extent to which the industry is prosecuted will largely depend upon experience at Billingham and in Cumberland. By-product ammonia producers, however, may derive comfort from the recent assertion of one authority that this form of ammonia will continue to compare with synthetic products, but that both will outbid Chilean nitrate in popularity and cheapness.

A question of considerable interest in connexion with present and prospective synthetic ammonia programmes is the form of ammonium salt which will be generally favoured. At present in this country we are almost solely familiar with the sulphate, but it is common knowledge that proposals are on foot for the production of other salts. Dr. E. J. Russell has said that on theoretical grounds the best salt for use as a fertiliser would be the carbonate, but it labours under the disadvantage of being volatile and easily decomposable, although a stable and odourless form of the bi-carbonate is said to be obtainable by treating the carefully-dried salt with moist carbon dioxide under pressure. Nitrate of ammonia is highly effective, but it is inclined to deliquesce, a drawback which, it is said, may be overcome by admixture with bone meal. Financially, the cheapest salt is apparently the chloride, and it seems most probable that the synthetic establishments will utilise at least a proportion of their ammonia for this purpose.

There has already been a good deal of discussion as to the relative efficacy of the chloride and the sulphate as fertilisers, but as regards nitrogen value it may be noted that ammonium chloride contains 26.2 per cent. of nitrogen, while the sulphate contains 21 per cent. Again, the difference from the point of view of transport is important since about 4 tons of chloride will do the work of 5 tons of sulphate. By recovering the ammonia as a chloride it is, of course, an easy matter to produce carbonate of soda as a by-product. It has yet to be shown whether there is any difference between the two compounds from the standpoint of the relative velocities at which crops react to the nitrogen they contain. Sulphate, however, has at least the advantage of an old-established and recognised name among farmers, and as in recent years it has improved so much in quality it is unlikely for some time to yield its place to an alternative form, which, if only on account of its novelty, is more likely than not to be suspected by the cautious consumer.

Potash and Activated Sludge

NITROGENOUS fertilisers are usually accorded so much attention that one is apt to overlook other varieties which are of equal importance. Phosphates and potassium salts, for instance, are just as necessary to plant life as nitrogen, but in general they are

employed in far smaller quantities—more particularly potash salts, which do not call for such frequent application. In this country the main source of phosphates is basic slag, a fertiliser which has become increasingly popular, while imported potash is supplied from the Alsace deposits now under French control and from the German works at Strassfurt. As is well known, the Alsace product contains mainly chlorides, in contradistinction to the German varieties which also contain sulphates.

Of growing interest are some of the natural organic manures which have more recently sprung into prominence. As an instance, one must necessarily refer to the activated sludge process, whereby sewage disposal may be conducted so as to yield a substance relatively rich in nitrogen and phosphorus. It has been said that the nitrogen lost by the wasteful disposal of sludge from sewage purification processes is one of the greatest economic wastes in the civilised world. For a complete and concise review of the whole subject of the utilisation of activated sludge we cannot do better than refer those of our readers who are interested to the comprehensive thesis on the subject which was submitted by W. D. Hatfield to the University of Illinois in 1918. This authority pointed out that (1) activated sludge has a chemical composition which indicates that it is far superior to ordinary sewage sludges as fertilisers; (2) the nitrogen is readily available—in fact, more so than in other organic nitrogen fertilisers; (3) the physical character of the sludge makes it easy to handle; (4) the grease content does not inhibit the fertilising value, probably because it is finely divided and in no way clogs the soil; (5) the dried sludge contains only spore-forming bacteria; and (6) the nitrogen and phosphorus content should give it a commercial value well above the cost of drying and preparation for marketing. In this country Ardern has given a detailed description of the process, and has pointed out that a million gallons of sewage will yield about 1,300 lb. of dry sludge, which will contain about 90 lb. of nitrogen and 50 lb. of phosphates. The problem as a whole is one of considerable national concern, and here again important developments may be expected in the future.

The U.S.A. Potash Industry

JUDGING by the alarmist articles which are now appearing in the United States chemical press, the hope of establishing an American potash industry is threatened with defeat by Germany. This is distinctly disappointing in view of the favourable reports of a year or more ago. Then we heard much of the Government's experiments with kelp; of developments in connexion with feldspar, greensands, alunite, natural lakes, and deposits in California. Large sums of money were raised in the interest of the new industry, and research was organised with a view to the production of a purer quality at a reduced cost. Mention is made of one large plant where the cost per unit of K_2O was reduced from 100 per cent. in 1919, to 32.6 per cent. in 1921. Behind all this activity there was a robust national sentiment in favour of American independence. Yet it all seems to have come to very little. High sentiment has yielded before hard business considerations.

Particulars are published concerning a contract, dated September 28, 1921, and entered into between

the American Chemical Co., and others, with Deutsches Kalisyndikat, G. m. b. H. Under this agreement thirty-four United States firms have agreed to purchase at least 75 per cent. of their potash requirements from the Syndicate, and this percentage, amounting to 35,680 tons, is to be taken in bulk in order to secure the special quantity discounts. As contracts for the remaining 25 per cent. have been placed with French interests, the United States potash producer finds himself without a market in his own country. This is the more disappointing to him because in November last it was agreed to offer American potash to meet any foreign quotation, even though this meant a loss to the producers. Is this due to a revival of German peaceful penetration, or to the superiority of the imported over the native article, or to the fact that American national sentiment is mere gas? It is difficult to say with certainty. The American-German potash entente seems, however, pretty strong when the seller undertakes in the contract referred to to pay any tax or duty on deliveries which may be imposed or assessed by the United States Government under the Anti-Dumping Act of 1921.

The potash position is in many ways analogous to the dyestuffs industry. We have not heard so much of this of late, but an opinion from Berlin may be worth quoting. One of the leading authorities on the German dye industry recently remarked to a contributor to THE CHEMICAL AGE that they were troubling very little about America; they were much more concerned with what Great Britain was doing.

Party Kite-flying

It is suggestive to note, in view of the rumours of a comparatively early general election, how eagerly rival political leaders are bidding for the Free Trade vote—represented very largely by the merchant community. On the one side, Sir Gordon Hewart and later the Prime Minister pledged the "National" Liberals to our traditional policy of free imports, and dismissed the Dyestuffs and the Key Industries Acts as mere incidents of quite a temporary nature involving no fundamental conflict with this policy. On the other side, Mr. Asquith, for the "Independent" Liberals, claims to be the special trustee of the Free Trade tradition, and instead of treating the measures referred to as incidental, insists on retaining them as the "acid tests" of the case. Of course, one can see in this the old game of political see-saw, in which each side seeks to exploit a situation for its own advantage, but the position is instructive as showing a suddenly recovered respect for the trader class and a desire to convince them that their true friends are to be found in this or that political group. Another thing brought home to the politicians is the fact that bureaucratic control of trade is now thoroughly discredited as the result of recent experiences, and that the best help the Government can render trade is to restore its freedom to act for itself. International trade is not to be set going by paper agreements at Cannes or Paris. It can only be re-established by the traders of various nations interchanging imports and exports in the ordinary way. The greater the facility with which they are allowed to get on with this essential work, the speedier will be the restoration of international confidence and credit.

Points from Our News Pages

- Some interesting notes, on "Indicators and Hydrogen Ion Concentrations" are contributed by T. Tusting Cocking, F.I.C., explaining the terms and abbreviations used and illustrating some of the uses and limitations of indicators (p. 94).
- Recent developments in processes for the production of neutral sulphate of ammonia are described and discussed by P. Parrish, A.I.C. (p. 97).
- In an article on "The Manufacture of Alkali Cyanides" a technical correspondent describes some features of the Bucher process (p. 99).
- Other special articles dealing with fertilisers are contributed by Dr. E. J. Russell ("Physico-Chemical Problems of the Soil"), J. Williams ("The Alsatian Potash Mines"), G. A. Cowie ("Potash in Compound Fertilisers"), F. C. O. Speyer ("Sulphate of Ammonia Position"), and N. V. S. Knibbs ("Manufacture of Lime Products").
- The inquiry as to whether calcium carbide has been improperly excluded from the Board of Trade list under Part I. of the Safeguarding of Industries Act, was concluded on Monday (p. 112).
- Our London Market Report records some improvement in the uptake of chemicals during the week, but the tone and volume of trade are described as disappointing, and the prospects of substantial improvement is uncertain (p. 118).
- According to our Scottish market report the past week proved better than anticipation in general chemicals in day-to-day business, and orders were more plentiful (p. 120).

The Calendar

Feb.		
1	Society of Public Analysts: Ordinary meeting. 8 p.m.	Burlington House, London.
2	Society of Chemical Industry, Bristol and S. Wales Section: "Some Local Aspects of Industrial Geology." A. H. Reynolds. 7.30 p.m.	University, Bristol.
2	Society of Dyers and Colourists, West Riding Section: Discussion on "Faults."	Bradford.
2	Society of Dyers and Colourists, Bradford Junior Branch: "Dyeing Machinery." F. Smith.	Bradford.
2	The Chemical Society: "The Action of Light on Silver Bromide." E. J. Hartung. "The Structure of the Benzene Nucleus." C. K. Ingold. 8 p.m.	Burlington House, London.
3	Society of Chemical Industry, Bristol and S. Wales Section: "The Manufacture of Oxygen." F. S. Sharpe. "Note on Roman Iron." J. Myers. 7.30 p.m.	University College, Cardiff.
3	Society of Chemical Industry, Manchester Section: "A Concentration of the Nitro-group in Aromatic Organic Compounds," "The Use of Potassium Bromate in Volumetric Organic Analysis." Drs. T. Callan and J. A. R. Henderson.	Textile Institute, Manchester.
4	London County Council: "The Relation between Pure and Applied Chemistry." Dr. M. O. Forster.	
4	Board of Trade: Safeguarding of Industries Act, Complaint under Sec. 1 (5), Cream of Tartar, Tartaric Acid, and Citric Acid.	

Indicators and Hydrogen Ion Concentrations

By T. Tusting Cocking, F.I.C.

INDICATORS are substances used to determine the end point of, or the completion of a definite stage in, a chemical reaction. They consist of an ever-increasing variety of bodies, the majority of which show the end of the particular reaction, the completion of which they are called upon to indicate, by the production, change, or disappearance of colour.

This present note deals solely with the class of indicators used in acidimetry, and the use of the word indicator herein-after is intended to refer to one belonging to this class. These indicators are organic colouring matters, allied to the dyes, and are commonly stated to exhibit different colours in acid and alkaline solutions. An indicator, however, does not necessarily indicate acidity or alkalinity, although all indicators will distinguish between a strong acid and a strong alkali. As will be explained later, the change in colour merely shows a change in hydrogen ion concentration.

Considerable uncertainty exists in the minds of many who have not studied the subject as to the meaning of the terms and abbreviations used in connexion with the use of indicators. The purpose of this note is to explain these in as simple a manner as possible and to illustrate briefly some of the uses and limitations of indicators. Everyone is familiar with blue and red litmus paper employed for the detection of acids and alkalis, and also with the commoner indicators used for the determination of the end points in acidimetry, but perhaps all do not realise why it is that phenolphthalein is a good indicator for weak organic acids, but of no use for weak bases such as ammonia, while methyl orange may be used for ammonia, but is useless for weak acids.

Dissociation Constants

According to the theory of electrolytic dissociation, when an acid is dissolved in water it is partly dissociated into hydrogen ions and acidic ions; it is to these hydrogen ions that the acidity of the solution is due. The amount of dissociation which occurs, that is, the proportion of dissociated molecules to undissociated ones varies with individual acids and also with the strength of the solution. A weak acid in strong aqueous solution is only very slightly dissociated; on diluting, the dissociation increases until at infinite dilution it is entirely dissociated into ions. The ratio of the product of the concentrations of the hydrogen ions $[H^+]$ and the acidic ions $[A^-]$ to the concentration of the undissociated acid $[HA]$ in the solution is known as the dissociation constant of that particular acid, and is represented by the symbol K_A ; that is, $K_A = \frac{[H^+] \times [A^-]}{[HA]}$. For instance, the K_A of salicylic acid equals 10^{-3} ; this means that in a solution of salicylic acid:

$$K_A = \frac{[H^+] \times [A^-]}{[HA]} = \frac{1}{1000} = 10^{-3}$$

In the same way a base dissolved in water dissociates into basic ions and hydroxyl ions; it is to the latter that the alkalinity of the solution is due. The ratio of the product of the concentrations of the basic ions $[B^-]$ and the hydroxyl ions $[OH^-]$ to the concentration of the undissociated base $[BOH]$ is known as the dissociation constant of the base, and is represented by the symbol K_B ; that is, $K_B = \frac{[B^-] \times [OH^-]}{[BOH]}$

These dissociation constants are based on experimental data, being calculated from very careful measurements of electrical conductivity, rate of inversion of sugar solutions, and hydrolysis of various salts and esters.

The concentration of hydrogen ions expressed in terms of grams of ionised hydrogen per litre of solution is represented by the symbol $[H^+]$ or C , thus $C_H = 10^{-6}$ means

that in 1 litre of solution there is contained one-millionth of a gram of ionised hydrogen. In the same way the symbols $[OH^-]$, $[HA]$, $[BOH]$, or C_{OH} , C_{HA} , C_{BOH} , represent the concentrations in terms of gram molecules per litre.

P_H Values

In order to simplify working conditions and to do away with the use of negative indices it is customary to state the hydrogen ion concentrations at which indicators show their colour changes in terms of what is known as the P_H values. P_H is the logarithm of the reciprocal of C_H , i.e., $\log \frac{1}{C_H}$; thus if $C_H = 10^{-6}$; $P_H = \log \frac{1}{10^{-6}} = 6.0$. P_H is therefore the index of the H ion concentration with the sign reversed.

The colour changes of indicators take place over definite ranges of H ion concentration. Methyl orange, whose range is from P_H 2.9 to 4.0, is red when the concentration of H ions is not less than $10^{-2.9}$. As the concentration decreases the colour of the indicator passes through orange until when $C_H = 10^{-4.0}$, the colour will be yellow. No further change will take place no matter how small C_H may become. Methyl orange is therefore useless to indicate any other range. Phenolphthalein will indicate a change in hydrogen ion concentration from 10^{-8} to 10^{-10} ; but it will not indicate over the range of methyl orange, and so on.

Thus each indicator has its own definite range which is usually expressed in terms of P_H , the first figure indicating the minimum H ion concentration at which the full acid colour is developed, and the second figure the maximum concentration for the full alkaline colour; transition colours being shown between these extremes.

Some indicators have more than one range. Thymol blue (thymol sulphone-phthalein), for instance, in a strong acid solution ($P_H = 1.2$) is red, from 1.2 to 2.8 the colour changes through orange to yellow, and remains yellow from 2.8 to 8.0. At 8.0 the second change begins, and is complete at 9.6, when the colour is blue.

Acidity

The acidity of a solution depends entirely on the amount of ionised hydrogen present. A strong solution of a weak acid (an acid that is only slightly dissociated in water) will have only a slightly sour taste. The concentration of H ions will be low, therefore P_H will be high, and it will require an indicator with a comparatively high P_H value to show its acid reaction. Conversely, a comparatively weak solution of a strong acid (one that is almost completely dissociated in water) will have a very sour taste; the concentration of H ions will be high, P_H will be low, and the solution will have an acid reaction to all indicators.

The strength of an acid is known by its dissociation constant; that of a very weak acid being very small, while that of a stronger acid is larger. A very strong acid, such as hydrochloric acid, has no dissociation constant, as it is almost completely dissociated in comparatively strong aqueous solution.

In former times it was usual to express the strengths of acids in terms of their avidities or affinities for bases; that is, the relative strengths compared with hydrochloric acid as unity.

Pure water itself dissociates to a small extent into hydrogen and hydroxyl ions. Its dissociation constant $K_W = 10^{-14.14}$ at $18^\circ C$, and the concentrations of the H and OH ions are exactly balanced. This balance is readily upset by the presence of dissolved substances. The addition of acid increases the concentration of H ions and decreases that of the OH ions, but the product of the two remains constant ($10^{-14.14}$). Alkali, on the other hand, decreases the H ion concentration and increases that of the OH ions.

It thus follows that all aqueous solutions, whether of acids, alkalis, or salts, contain both hydrogen and hydroxyl ions. The product of the concentration of these two ions is constant for a definite temperature (10^{-14} at $18^{\circ}\text{C}.$), whatever the solute may be.

It is usual to state the acidity or alkalinity of all solutions solely in terms of H ion concentrations, and to ignore the OH ions, but as $C_{\text{H}} \times C_{\text{OH}}$ always equals 10^{-14} at $18^{\circ}\text{C}.$, the concentration of the OH ions may be calculated readily, if required.

Absolute Neutrality

Pure water is taken as the standard of absolute neutrality, as the concentrations of its hydrogen and hydroxyl ions are equal, $C_{\text{H}} = C_{\text{OH}} = 10^{-7.07}$ and $P_{\text{H}} = 7.07$; consequently all solutions whose P_{H} is less than 7.07 will be acid, and those with a P_{H} over 7.07 alkaline. It follows that pure water will react alkaline to indicators which show a change below P_{H} 7.07, and acid to those changing above 7.07. Thus an aqueous solution of methyl orange ($P_{\text{H}} = 2.9-4.0$) is yellow, while that of phenolphthalein ($P_{\text{H}} = 8.0-10.0$) is colourless.

It should be noted that the figure 7.07 refers to specially purified distilled water. The reaction of ordinary distilled water is considerably affected by dissolved carbon dioxide from the atmosphere, and frequently by traces of impurities due to solvent action on its container, such as alkali from glass.

Neutral Salts

The P_{H} value of solutions of neutral salts (salts produced by replacement of the whole of the acidic hydrogen of an acid by its equivalent of a base) very rarely correspond with absolute neutrality. Aqueous solutions of salts of strong acids and equally strong bases, or of weak acids and correspondingly weak bases will have P_{H} values very near to 7.0; but, in the case of a salt of a strong acid and a weak base P_{H} will be low, while the reverse will be the case with a weak acid and a strong base, e.g., P_{H} of an N/20 solution of aniline hydrochloride is 3.0, that of sodium cyanide is 11.0.

The P_{H} of solutions may be determined approximately by means of different indicators; thus a decinormal solution of ammonium chloride is alkaline to methyl orange (P_{H} 2.9-4.0) and acid to phenol red (P_{H} 6.8-8.4) consequently its P_{H} lies between 4.0 and 6.8. It is found to be neutral to methyl red (P_{H} 4.2-6.3), thus further narrowing the range. Its actual P_{H} is 5.3.

Buffer Solutions

The exact value is usually determined by comparison with so-called "Buffer" solutions. These consist of solutions of various salts to which varying quantities of acid or alkali have been added, and exhibit definite H ion concentrations, which, owing to the "Buffer" action of the salts are not readily changed by traces of impurities, and they may be relied upon as standards.

A solution of any required P_{H} might theoretically be made by diluting a strong acid such as hydrochloric acid or a strong base (sodium hydroxide) with the requisite amount of pure water, but although this is quite practical as regards N/10 HCl ($P_{\text{H}} = 1.04$) and N/10 NaOH ($P_{\text{H}} = 13.2$), it would be quite impracticable at dilutions of N/1,000,000. Such solutions would be extremely sensitive to minute traces of alkali from glass containers and to carbon dioxide from the air, and one could not rely on them.

It is therefore essential to employ salts which exert a "buffer" action, that is, cause the change in H ion concentration on addition of acid or alkali to be very gradual and likewise the colour change of the indicator. This is the reverse of what is required in titration, where as sharp an end point as possible is aimed at. Thus a comparatively large amount of hydrochloric acid may be added to a solution of sodium acetate without causing more than a slight alteration in the H ion concentration, but the same amount of the acid added to pure water will change it enormously.

The principal salts used as buffers are acetates, borates, citrates, phosphates, and phthalates. By means of such salts solutions of known P_{H} values ranging from 1 to 13 are readily prepared. With careful storage they will keep without alteration indefinitely.*

By mixing varying quantities of one-fifteenth molecular (M/15) solutions of di-sodium hydrogen phosphate Na_2HPO_4 ($P_{\text{H}} = 4.5$) and of potassium di-hydrogen phosphate KH_2PO_4 ($P_{\text{H}} = 9.2$) any P_{H} between 4.5 and 9.2 may be obtained. (In actual practice phosphates are used only between P_{H} 6.0 and 8.0.) A series of test tubes containing such solutions, with the addition to each of the same quantity of an indicator whose P_{H} corresponds with this range will show a very gradual colour change, each shade corresponding to a definite P_{H} value. Thus, in order to find the P_{H} of any solution, it is only necessary to add the correct quantity of a suitable indicator, and compare the colour obtained with a series of buffer solutions containing the same quantity of the same indicator.

Mixed Indicators

By the use of carefully selected mixtures of indicators, it is possible to determine the approximate P_{H} of any fluid without the aid of buffer solutions. Such mixed indicators show a number of different colour changes over a large range. The average observer can recognise the six spectrum colours and their half-way shades with a fair degree of accuracy without a colour comparison, and if the colours assumed by the indicator are calibrated, initially against buffer solutions, it follows that any P_{H} value within the range of the mixed indicator can be determined approximately at sight.

Recent investigations have shown the great importance of determining the hydrogen ion concentration of various fluids. Particularly is this the case with all fluids upon which life, both animal and plant, depends. It has been found that many vegetable organisms such as bacteria, yeasts, and even higher plants can exist only in media of definite H ion concentration, and that a comparatively small alteration of this is sufficient to inhibit growth. It is thus of the greatest importance in preparing any bacteriological culture medium to ensure that it has the most suitable P_{H} value for the particular bacteria it is intended to grow.

(*Vide* "The Reaction of Media," National Health Insurance pamphlet.) The activity of all unorganised ferments such as diastase, pepsin, and pancreatin is dependent upon the H ion concentration of the medium. It has been shown that in determining the diastatic value of malt, varying results may be obtained owing to the varying acidities of different starches, and that by standardising the P_{H} value, concordant and higher results are obtained (*J.S.C.I.*, 1920, T. 311).

A great variety of new indicators belonging to the phthalein and sulphone-phthalein classes, together with their bromine derivatives and certain azo-dyestuffs, are now available for P_{H} determinations. Mainly as the result of recent investigations, it is now possible to choose a good indicator for any P_{H} value from 1.0 to 12.0. These indicators are finding a growing use in analytical work, and, as a result, new methods of titration are being devised and old ones improved.

In many cases mixtures of a strong and a weak acid, such as hydrochloric and acetic acids, or a strong and a weak base such as sodium hydroxide and β picoline can be successfully estimated by simple titration using two indicators with different P_{H} values, for the two end points (H. T. Tizard and A. R. Boeree, *J.C.S.*, 1921, T. 132).

Choice of Indicators

For the titration of a strong acid against a strong base, or *vice versa*, almost any indicator may be used with good results, as the addition of a very small quantity of either

*Precise details and formulæ for the preparation of Buffer solutions may be found in "The Theory and Use of Indicators," E. B. R. Prideaux, and "The Determination of Hydrogen Ions," W. Mansfield Clark.

acid or alkali at the neutral point will alter the P_H value to a large extent, and thus give a sharp colour change. When a weak acid or a weak base is titrated against a strong base or strong acid, and even more particularly when the titration is between a weak acid and a weak base the indicator must be chosen with great care, or results far from the truth may be obtained. In such cases it is of paramount importance to know the P_H values of the solutions of the neutral products, and they must be determined either experimentally, or by calculation from the dissociation constants of the acids and bases. The indicators chosen, of course, must be those whose change points are very near to the values found.

A one-fifth normal (N/5) solution of acetic acid has a P_H value of about 2.7, it is therefore acid to methyl orange, and to all indicators whose P_H is over 2.7. The P_H of decinormal (N/10) sodium acetate is about 9.0. When titrating N/5 acetic acid against N/5 sodium hydroxide, it is therefore necessary to choose an indicator with a P_H value somewhere in the neighbourhood of 9.0. If methyl orange ($P_H = 2.9-4.0$) be used it will begin to change with the first addition of alkali, and the change will be complete when about 16 per cent. of the acetic acid had been neutralised. Bromo phenol blue ($P_H = 2.8-4.6$) would likewise show a colour change from the beginning of the titration, but the change would not be complete until about 40 per cent. of the acid was neutralised. Methyl red ($P_H = 4.2-6.3$) would complete its colour change when about 97 per cent. was neutralised. The change in colour of these three indicators on addition of the alkali would be very gradual owing to the buffer action of the sodium acetate formed, and it would be impossible to judge correctly when the change was complete. Bromo-cresol purple ($P_H = 5.2-6.8$), bromo-thymol blue ($P_H = 6.0-7.6$) and phenol red ($P_H = 6.8-8.4$) would give increasingly better results and sharper end points, but the best result and sharpest end point would be obtained with an indicator like phenol-phthalein ($P_H = 8.0-10.0$).

If it were required to titrate N/5 acetic acid against N/5 ammonia the conditions would be very different. Acetic acid is a weak acid and ammonia a weak base; both have the same dissociation constant $K_A = K_B = 1.8 \times 10^{-5}$, therefore the P_H of ammonium acetate solution will be very near to 7.0, and as ammonium acetate exhibits a very strong buffer action it is essential that the indicator chosen should change over at, or as near to this point as possible. The best indicator in this case would be bromo-thymol blue ($P_H = 6.0-7.6$), but owing to the gradual colour change and poor end point it would be necessary for reasonably accurate work to titrate until the colour was identical with that given by a previously prepared buffer solution of P_H 7.0. Phenolphthalein would give a useless result.

For the titration of N/10 ammonia against N/10 hydrochloric acid, methyl orange is commonly used, and recently bromo-phenol blue has been recommended. Of these two indicators, bromo-phenol blue will give the more correct result, but it will be approximately accurate only when the full alkaline colour of the indicator is taken as the end point. Thus if the ammonia be added to the acid until the full colour change takes place, a good result will be obtained, but if the order of mixing be reversed and the titration carried to the acid colour of the indicator, the result will be about 3 per cent. higher. Methyl red ($P_H = 4.2-6.3$) is the best indicator for this purpose; it will give the sharpest and most accurate end point as the half-way point of its range coincides with the P_H value (5.3) of ammonium chloride solution, and the titrations will not vary by more than about 0.1 per cent. if the order of mixing be reversed.

The P_H value and the total acidity of a solution of an acid bear a definite relation to each other. This relationship is dependent on the dissociation constant of the acid, and in its simplest form may be expressed algebraically thus: $C_H = \sqrt{K_A C}$ where C = concentration of the acid in terms of normality.

A 0.001 normal solution of hydrochloric acid (which is dissociated almost completely) has a P_H value of 3.0. It contains 0.0365 gram HCl equal to 0.001 gram of total and also ionised hydrogen per litre. To produce a solution of acetic acid ($K_A = 1.8 \times 10^{-5}$) with a P_H of 3.0, it is necessary to make it 58 times the corresponding strength, i.e., 0.058 normal. This will contain 58 x 0.060 gram CH_3COOH equal to 0.058 gram of total hydrogen, but only 0.001 gram of ionised hydrogen per litre.

Synthetic Gold Research

To the Editor of THE CHEMICAL AGE

SIR,—The temporarily lost art of the Egyptians in making gold—like the output of their pigments, colours, beads, and cements—is rather ignored by present-day scientists. Professor Irving's lecture before the London School of Economics has brought to light the discovery by the German chemists of the manufacturing of gold from baser metals, and they say that it only remains to cheapen the process. If this is so, it can soon be brought about, where water power can be harnessed to drive the appliances necessary in the electric vacuum furnaces.

About 1901 the writer purchased nuggets of manufactured gold from a Gold Coast native gold worker, in a village not far from Mansu, Gold Coast Colony. This native smelter's stock-in-trade consisted of a clay furnace, blow pipe, native bellows, and the raw material was heaps of crushed rock and base metals, and a small pile of infusorial earth (diatomiet or kieselguhr). These nuggets were shown to several employees at Messrs. Millers' Stores at Axim in 1901, who expressed surprise at the writer getting such a quantity of nuggets of gold.

Regarding cheapening the process for manufacturing gold, Austria is already developing the Styrian water-power works, which will be capable of a total output of 450,000 H.P., or about one-quarter of the water-power of Austria. And as this country possesses an abundance of the necessary base metals for making gold, with cheap labour and water power, it should soon be a keen competitor with Germany in the making of synthetic gold. There is nothing impossible in making gold by the vacuum-electric furnace on a commercial basis, if cheap and requisite water power is available.

It is well known that sea water contains gold, in some parts of the world greater than others. For instance, about 200 miles of the coast line from the Ivory Coast, down the Gold Coast, a very large percentage of gold can be obtained from the sea water flowing along its shores, and it remains to be seen whether a cheap process of filtration through tanks, or a chemical-electrical treatment of sea water through pipes, using tidal power, may not pave the way to commercial development of the sea water of the Gold Coast Colony.

Yours truly,

L. P. BOWLER (Captain).

London, January 18.

Declining Trade in Chilean Nitrate

THE authorities of the Panama Canal are seriously concerned in the large decrease of nitrate shipments from Chile, which made up in 1920 one-third of the total north-bound cargo. In an analysis of the nitrate situation, prepared by Mr. A. Bertrand, the delegate in Europe of the Association of Nitrate Producers, it is stated:—

"Before 1908, nitrate had but one rival, sulphate of ammonia, with a development very inferior to nitrate. From 1909 to 1913 cyanide and nitrate of calcium began to make their appearance, while at the same time the production of sulphate of ammonia increased much more than that of nitrate. In 1913, in its turn, synthetic ammonia made its appearance, though in a small proportion. In that year nitrate was still dominant. In 1917 the development of nitrate reached its maximum capacity. Synthetic ammonia was produced to a maximum degree in Germany in 1918. Sulphate of ammonia, extracted from coal, seems to have reached its full development in Germany and the United Kingdom and especially in the United States, while it continues to increase in other countries, notably Australia and Japan. At present the moment, the production of chloride of ammonia and other new salts is being encouraged for the purpose of fertilization. To sum up, nitrate, which represented 56 per cent. of the world's total fertilizer production in 1913 to 1917, has fallen to-day to less than 35 per cent., according to the most favourable calculations, and it seems threatened with a descent to still lower depths in the current year."

Development in Neutral Sulphate of Ammonia Processes

By P. Parrish, A.I.C.

It is now no longer necessary to urge the importance of the production of neutral ammonium sulphate of good physical texture and colour. Practically all are agreed that within the next two years acid-containing sulphate of ammonia will be an almost unsaleable product.

In the early part of 1914, when the synthetic ammonium sulphate manufactured by the Germans was introduced to the United Kingdom, it became evident that an improvement of the quality of sulphate of ammonia as hitherto manufactured in this country would be inevitable. Unfortunately, the advent of the European war was responsible for a diversion of effort, and interest in this subject does not appear to have been openly revived until the early part of 1917, when the Capron process for the production of neutral sulphate of ammonia was published. Since that time many processes have been introduced, by which acid-containing sulphate of ammonia can be converted to neutral ammonium sulphate, or by which neutral ammonium sulphate can be directly produced. These processes may be classified as follows:

- (1) Washing or spraying processes: (a) With atomised water; (b) with treated mother liquor; (c) with weak solutions of ammonia, variously obtained.
- (2) Treatment with gaseous ammonia under moderate pressure.
- (3) Incorporation of a neutralising agent in a solid form.
- (4) Production of neutral ammonium sulphate within the saturator or saturators.

The suitability and efficacy of any spraying process depends to a large extent on the physical characteristics of the acid-containing sulphate of ammonia to be treated, the extent to which the dissolution of the salt is effected, the purity of the washing medium, and the loss of ammonia which arises during such neutralising process. The finer points in the production of acid-containing sulphate of ammonia are as yet only appreciated by comparatively few chemists and technicians. The failure to appreciate these finer or more delicate points has occasioned much disappointment and involved, in some cases, not a little expense.

Washing processes are not universally applicable, and hence cannot be universally effective. It is necessary to appreciate that conditions vary according to the character of the sulphate of ammonia process adopted, and that the acid-containing salt produced with the usual type of gasworks plant is dissimilar in at least one essential to the salt produced on a coke oven semi-direct recovery plant. With the latter process conditions are not so regular as is the case with a typical gasworks sulphate of ammonia plant. It is rarely possible to maintain the gas liquor still in continuous operation on a semi-direct coke oven works. Apart from this cause of irregularity of working conditions, the temperature of the bath at such plants scarcely ever exceeds 50°C., except with the Koppers plant, where preheating of the gases is provided, and the possibilities of the formation of rock-salt are much more prolific than is the case in a gasworks plant working under normal conditions.

Indeed, to overcome the formation of rock-salt at coke oven semi-direct plants, it is not unusual to work the saturator with an intermittent feed of sulphuric acid. The bath, when charged, has an acidity of about 15 to 20 per cent. H_2SO_4 , and is worked to about 8 to 10 per cent. H_2SO_4 before being recharged. Generally speaking, this method of procedure has been effective in obviating the formation of rock-salt. But when one approaches such procedure from the point of view of the application of a washing process, it is found that the method has its accompanying disadvantages. Not only is the salt produced in an exceedingly fine state of division, aiding the retention of acid mother liquor, forming an almost impermeable salt bed on centrifuging, and possessing

a low ratio of crystal surface to crystal mass, but evidences are not wanting which suggest that crystals of ammonium bisulphate are produced with the high acidities named.

Neutralisation of ammonium bisulphate is only possible when this compound is definitely dissolved. It is clear, therefore, that unless the conditions under which sulphate of ammonia is manufactured at coke oven semi-direct plants are modified, washing processes will prove ineffective. The inference to be deduced from the foregoing is that continuous operating conditions (*i.e.*, continuous feed of acid to the saturator, and regular and continuous distillation of the ammoniacal liquor) are important considerations as affecting the efficacy of washing processes in the production of neutral ammonium sulphate, by the neutralisation of acid-containing sulphate.

Experience has revealed that, given the best conditions of operation, it is impossible to produce consistently neutral ammonium sulphate by the application of atomised water (hot or cold). The acidity of acid-containing sulphate of ammonia can certainly be reduced by this process, but not to such limits as will enable one consistently to produce and sell neutral ammonium sulphate. Apart from this aspect, a tolerably appreciable dissolution of salt accompanies the application of this process, and this cannot be regarded other than as a disability.

The use of mother liquor treated in the manner covered by Capron's patented process has not proved a success. This is attributed to at least two causes: (a) Failure on the patentee's part to appreciate what was involved in the application of his process to works practice; and (b) one suspects that the experiments confirming the conception of the process were conducted with comparatively pure chemicals, and that some of the disadvantages attending the practical application of the process had remained unrevealed.

If an average sample of mother liquor as produced in the manufacture of sulphate of ammonia on a typical plant is neutralised with pure ammonium hydrate, or pure gaseous ammonia, it is evident to a tyro that such a solution is peculiarly unsatisfactory, by reason of its dirty character, as a neutralising medium. It should be remembered that in the original attempts made to apply the Capron process, the crude gases leaving the primary still were employed for neutralising the mother liquor. This led to the production of a still dirtier neutralising medium, and to an irregular and not dependable supply. To these causes the failure of the process must be ascribed.

Of the processes which depend on the use of a weak solution of ammonia, it is no exaggeration to say that the Metro process, described by Mr. E. V. Evans, F.I.C., in his paper to the Southern District Association of Gas Engineers and Managers in November, 1920, has been singularly successful. The neutralising medium covered by this process is available in adequate quantity of a peculiarly pure quality, at will, without entailing extra manipulation or labour.

The process acts in a dual way. Direct neutralisation proceeds concurrently with the elimination of acid mother liquor due to the passage of the washing medium through the salt bed. Thus only half the theoretical quantity of ammonia solution is required to ensure complete neutralisation. The loss of gaseous ammonia is negligible, and by the use of acid of 70 to 72 per cent. there is no accumulation of mother liquor.

It is true that a suitable medium can be produced by distilling sulphate of ammonia with lime, or by the production of liquor ammonia and its subsequent dilution with water, but these methods entail extra plant and labour extraneous to that of the usual sulphate of ammonia process.

The treatment of acid-containing sulphate of ammonia by gaseous ammonia under moderate pressure does not

appear to have gained much favour. It is appreciated that such a process can be applied with ease at works possessing anhydrous liquid ammonia plant where gaseous ammonia is available under pressure, and where dilution with air presents little difficulty, but the application of the process is not nearly so easy at other works. Irrespective of the latter consideration, to ensure uniform and effective neutralisation the process involves that the heaps shall be constituted of salt of regular texture, giving interstices of a fairly uniform free space. The writer's experience of heaps of most qualities of acid containing sulphate of ammonia is that there is a wide variation in the texture of the salt, and inferentially in the free space of the interstices, and that uniform and effective neutralisation is not nearly so easy as may be imagined. It is feared that by this process zones of unneutralised salt will occur. Moreover, in breaking down such heaps after the "gassing" process has been applied, there is inconvenience due to the release of occluded ammonia and pyridine, which occasion inconvenience to the men engaged on such work.

The incorporation of a neutralising agent in a solid form appears to be a rational way of effecting the neutralisation of acid-containing sulphate of ammonia, provided a suitable agent is used. The writer would discountenance the use of lime because it introduces another impurity to the salt, and the trend of events suggests that sulphate of ammonia of the highest purity is a desideratum. Where incorporation of the neutralising agent is ensured by a process involving grinding it is feared that the texture of the resultant product will suffer. One advantage of methods of neutralisation of this character is that neutralisation and drying can proceed simultaneously, but whether suitable and foolproof plant has yet been found to effect these objects is unknown. That such plant can be devised there is no doubt.

The production of neutral ammonium sulphate within the saturator, or saturators, is a process to which considerable attention has been directed for at least five years. Such a process was patented by the South Metropolitan Gas Company and E. V. Evans (E. P. No. 111,309) in 1918, and whilst this process appreciates fully the chemical and technical difficulties involved, considerations of operating costs have rendered its adoption impossible.

The Hansford (Bedford) process is one which comes under this category. That neutral ammonium sulphate can be produced by this process, outlined in detail in a paper read at a meeting of the Eastern Counties Gas Managers' Association in September (*Gas World*, October 1, 1921, Coking Section, p. 13) is not questioned. But whether such a process is alike applicable to large works and will produce a salt of sufficient purity and reasonable colour to admit of ready sale is open to doubt. Before neutrality of the bath is reached, precipitation of the tarry and organic matter accompanying the gas liquor and other impurities of the sulphuric acid will have occurred, and unless the agitation of the saturator is peculiarly effective, local alkalinity will have been produced. If any volatile cyanides have accompanied the gases from the still (and volatile cyanides will be present in such gases, unless the gas liquor has been effectually oxidised by long standing, or by the application of a suitable process of fixation), then the formation of ammonium ferrous ferrocyanide, the precursor of blue salt, is inevitable. Moreover, in any case, trouble with the formation of rock-salt must accompany the use of the Hansford process, and this is a disability which is not lightly contemplated by those conversant with the details of sulphate of ammonia manufacture.

It is feared that the Hansford process is too crude, in its present form, to admit of adoption. With suitable modification it can be transformed to a workable and generally applicable process for the manufacture of neutral ammonium sulphate. Application for a patent to cover a process providing for the production of neutral ammonium sulphate within the saturator was made many months prior to the publication of the details of the Hansford process by the company with which the writer is associated. This process contemplates

the various difficulties which have been recounted, and suitable provision is made for overcoming such difficulties. Pending the acceptance of the final specification, which has been lodged, further reference is obviously impossible, except to say that the process will prove a positive one.

A suitable process for the manufacture of neutral ammonium sulphate by the coke oven semi-direct, or direct, process is one for which application has also been made. Until the final specification is accepted, it is impossible to reveal the details of the process. It can, however, be said that this process provides for the preliminary treatment of the acid-containing sulphate of ammonia magma, as ejected by compressed air from the saturator, with a specially prepared neutralising medium before centrifuging. There is every reason to believe that this method will prove a peculiarly suitable one in actual practice, for ensuring the production of a consistently neutral salt of good colour in connexion with coke oven semi-direct plants.

Enough has been said concerning the developments of neutral sulphate of ammonia processes to indicate which are the ones likely to gain favour, by reason of their dependable and foolproof character. In the writer's view, however, it is not alone sufficient to produce neutral sulphate of ammonia. Neutral dry sulphate of ammonia is the order of the day, and this quality of sulphate will be almost universally demanded ere long. No longer must the manufacture of sulphate of ammonia be regarded as a process which can be conducted by a gasworks stoker, and controlled by an over-worked gas manager. It can be affirmed that the manufacture of dry neutral sulphate of ammonia, of suitable colour and uniform texture, is decidedly a chemical process, demanding attention to many details, and involving trained processmen and chemical control, such as the more intelligent and appreciative continental chemical manufacturers have been accustomed to afford in connexion with the production of various fine chemical products for many years past.

The Nitrate Market

Sales on Limited Scale: January Shipments

In their report dated January 18, Aikman (London), Ltd., state that the corrected quantities of nitrate of soda carried by steamers are advised as follow:—"Theban" ss. 1,970 tons; "Atlantehavet" ss. 6,860 tons; "Poplar Branch" ss. 4,400 tons; "Duendes" ss. 1,970 tons; "Nitokris" ss. 3,950 tons, and the "Ovid" ss. 5,230 tons. The "Nitokris" ss. discharged 500 tons at Antwerp and 3,450 tons at Hamburg, and the "Plum Branch" ss., with 1,970 tons, is destined for London, instead of as previously stated. The arrivals advised have been:—"Garthwray" 2,900 tons, from Taltal, ordered to Leith; "Oak Branch" ss. 2,960 tons, from Taltal, &c., passed for Dunkirk; and "Winsum" ss. 4,830 tons, from Iquique, arrived direct Leghorn. The arrivals amount to about 11,000 tons, and about 20,000 tons are due during the next fortnight.

The demand, the report states, still continues very quiet, and sales in consuming centres have been on a very limited scale. The severe weather that is now being experienced is likely to accentuate this position for the time being. Pool prices on the Continent are unchanged, with small re-sellers at a slightly lower figure. In f.o.b. nitrate no business has been reported, but near deliveries could be bought at 10s. 2½d. to 10s. 3d. per quintal. The shipment figures for the first fortnight of January are as follow:—

	1922. Tons.	1921. Tons.	1914. Tons.
Shipments to Europe and Egypt	14,000	51,000	71,000
Shipments to United States..	7,000	22,000	7,000
Shipments to Japan and other countries	12,000	2,000	10,000

The production figures for December were cabled as follow:

	1921. Tons.	1920. Tons.	1913. Tons.
Production, December..	74,000	220,000	230,000
Stocks in Chile, Dec. 31	1,449,000	1,304,000	498,000

Freights remain unchanged, with liner rates at from 25s. to 27s. 6d. and tramp tonnage nominally about 30s. per ton. The exchange has fallen to 46.79 pesos to the £.

The Manufacture of Alkali Cyanides

Notes on the Bucher Process

The following article deals with one of the less commonly described methods for the fixation of atmospheric nitrogen. The use of the cyanide producing reaction in this connexion is the oldest method, with one exception, for the fixation of nitrogen. In spite of this, however, the production of cyanides "from the air" has not been so successfully developed as the better-known fixation processes, and many technical failures have to be recorded.

THE importance with which the problem of the fixation of atmospheric nitrogen is regarded to-day requires no extensive elaboration here. There are several methods which are available and which are at present in operation or are about to be put in operation in this country. It is necessary merely to refer to the Haber process, in which the direct combination of nitrogen and hydrogen is effected by means of a suitable catalyst; to the cyanamide process, in which nitrogen is caused to combine with calcium carbide; and to the arc process, in which the combination of nitrogen and oxygen is effected through the medium of intense electric energy. The fixation of atmospheric nitrogen, however, in the form of an alkali cyanide by means of the reaction between an alkali, carbon, and nitrogen (a reaction which may be facilitated by the presence of a catalyst), has received comparatively little attention in general chemical literature.

Of all the methods now employed for the fixation of nitrogen, the "cyanide" method is the oldest, with the single exception of the arc process. It is well-known that Cavendish, in 1784, observed the production of nitric acid when nitrogen and oxygen were sparked over an alkaline solution. Priestley had previously noticed the contraction in volume when air was submitted to such electrical treatment, but it was left to Cavendish some short time later to extend and explain the former's observation.

The reaction between nitrogen, an alkali, and free carbon to produce alkali cyanide, was discovered by Desfosses in 1828, although for some time it was a moot point whether or not the nitrogen were not present in the reaction mixture, namely, in the carbonaceous matter used, and therefore, not really "fixed" from the atmosphere. The correctness of the observations of Desfosses is now, however, apparent, and the cyanide process for nitrogen fixation may take an honourable place among historical chemical reactions.

There is one essential difference between the history of the oldest two methods. The arc process was regarded, until modern times, as merely an interesting chemical fact, and its commercial possibilities were undreamed of until the supply of very cheap electrical power became available, for instance, in Norway. The technical possibilities of the cyanide process were, however, realised within comparatively few years after its basic reactions were discovered, and commercial operations were started as early as 1840. Possoz and Boissiere confirmed the original observations of Desfosses, and erected a factory in France, whilst similar operations were carried out at Newcastle in this country by Bramwell & Co. Both factories had, however, a short life, and were the first of many skeletons which have strewn the road to success in nitrogen fixation through the medium of alkali cyanide.

Until comparatively recently the object sought in such processes has not been the production of a fertiliser or an intermediate for the production of a fertiliser, but to discover a cheap method for the production of cyanide itself. The older methods, in which ferrocyanides served as starting material, were costly and cumbersome, and when, in 1840, Elkington discovered the process of gold and silver plating from a cyanide bath, a greater demand for cyanide sprang up and still more attention was paid to the process of Desfosses. Before passing to a consideration of the Bucher process for the production of cyanide—probably the only process which has been in successful technical operation under economic conditions—it may be worth while to devote a short space to the history of the only other method for the fixation of nitrogen as cyanide, which has had any considerable attention paid to it. This process consists in the utilisation of barium oxide or carbonate as the base upon which is fixed the hydrocyanic acid radical. In 1860, Margueritte and De Sourdeval discovered that barium oxide reacted with carbon and nitrogen at a lower temperature than was necessary in the case of the fixation of nitrogen by means of alkali and carbonate. This process has had a chequered career, and it has been developed in recent years in this country, with every prospect of success. There have been, however, many failures. Readman, in 1894, used this process in conjunction with an electric furnace.

The mixture of barium oxide and carbon was heated to the required temperature and a current of nitrogen passed. The barium cyanide produced was treated with sodium bicarbonate so that sodium cyanide was produced and a carbonate of barium, suitable for re-use in the nitrogen fixation process, was precipitated. Many difficulties were encountered, especially as a result of the high temperatures required, leading to great depreciation charges upon the process, and also to the inadequate grasp of fundamental chemical principles, such as the reversible nature of the reaction, for example, in the action of the carbon monoxide produced upon cyanide.

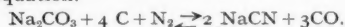
Probably the most astounding thing in the history of this method of nitrogen fixation by means of an alkali and carbon, is the fact, mentioned by Bucher, of the apparent entire neglect or overlooking of the work of Thompson. As early as 1839, Thompson showed in no uncertain manner his opinion regarding the value of iron as a catalyst for the cyanide producing reaction. He says: "I found it necessary to use iron."

When iron is not employed, a much higher temperature is required." The significance of Thompson's work can only be thoroughly appreciated when the confirmation at the hands of Bucher is studied. The amazing differences in the speed of the fixation reaction and the temperatures required are amply demonstrated in parallel experiments, and it is obvious that if these experiments had been carried out by previous investigators, and their importance realised, many of the failures of the past would not have occurred.

The Bucher Process

In his communication to the *Journal of Industrial and Engineering Chemistry*, 1917, p. 233, Bucher calls attention to the pioneer work of Thompson upon the influence of iron upon the reaction, showing the possibility of carrying out the process at a lower temperature. At the time these investigations of Bucher were made public, the United States had not entered the war, but great attention was being paid to the self-supporting state of the country in view of the probable declaration of war with Germany. One of the problems confronting the Americans, as, indeed, all belligerent countries, was the ensuring of an internal supply of fixed nitrogen, either nitric acid or an intermediate nitrogen compound from which the acid could be prepared. Thus, Bucher was led to advocate the establishment of a process based upon his researches for the fixation of nitrogen as cyanide. The process was considered as the most suitable emergency method, since it involved the creation of no large power development systems, and could be set going at once. Moreover, since the raw materials, sodium carbonate, coke, iron and nitrogen (contained in producer gas) were available in quantity and at a relatively low cost, and the plant required was not such as to require special construction and expert engineering skill and research, it was held that the process was ideal in the circumstances. A commercial plant of large capacity was erected under the auspices of the American Government for the production of cyanide of sodium, which was to serve as an intermediate in the manufacture of toxic gases.

Bucher demonstrated that the catalytic influence of iron was very marked in the reaction between metallic sodium, carbon and nitrogen, and the difference in the production of cyanide in parallel experiments in which iron was and was not present, causes us to reflect with surprise upon the observations of Thompson, whose work, suitably adapted, should have ensured the success of many ventures prior to Bucher's. The observations with metallic sodium were soon followed by the realisation that the catalytic effect of iron was equally pronounced in the case of the reaction of the alkali carbonates with carbon and nitrogen, as indicated by the following equation.



The production of sodium cyanide does not proceed directly as in the above equation according to Bucher, but through

the intermediary of metallic sodium. The latter is produced in very small quantities at the temperatures of the working process suggested, namely, about 950°C ., by the reduction of sodium carbonate with carbon. The metallic sodium rapidly combines with carbon and nitrogen, and the influence of the iron catalyst is very marked here, as had previously been demonstrated. Thus the metallic sodium was removed from the sphere of reaction as quickly as formed, and a further small quantity was produced by reduction of the carbonate, and so on until reaction was complete.

The fact that producer gas can be used in place of pure nitrogen when a temperature of 950°C . is employed as stated by Bucher, has recently been shown to be incorrect but this is of little consequence in these days when pure nitrogen is capable of large scale production at a comparatively low cost.

Passing over, in the meantime, such practical considerations as the maintenance of a non oxidising atmosphere around the iron retorts, so as to minimise rapid breakdown, and the briquetting of the charge of carbon, soda ash and finely pulverised iron, it may be stated that Bucher clearly showed the possibility of producing a high yield of cyanide by this method.

Assuming that the formation of cyanide in the retorts is a settled problem and that the use of iron enables the manufacture to be carried out at a workable temperature, the problem of the lixiviation of the cyanide from the cyanised briquettes still remains.

In the original Bucher process this was effected by means of water under certain regulated conditions. At temperatures below 35°C . the cyanide in the briquette combined with water to form a crystalline salt, which easily sets as hard as Plaster of Paris. At temperatures in the region of 100°C ., there is a great tendency towards the formation of ferrocyanide, by the interaction of cyanide and iron, and upon evaporation of the solution, an impure product results. In technical operations too, it often happens that a full conversion of the alkali carbonate is not effected, and the excess goes into solution with the cyanide produced upon lixiviation with water. The same applies to the sodium hydroxide formed in the process to some slight extent. One final objection to the lixiviation with water is the comparative length of time spent in the operations, and the difficulty of drying the cyanide obtained upon evaporation of the solution.

Ammonia as a Solvent

The use of liquid ammonia as solvent in technical operations would seem at first sight to be impossible from an economic aspect. The advantages which this solvent possesses in the operation of the Bucher process are, however, so great that close investigation of the possibility of its use was very desirable. The engineering and economic problems were satisfactorily solved at the United States Government plant at Saltville, and the use of liquid ammonia thoroughly justified.

Liquid ammonia dissolves sodium cyanide easily, but sodium carbonate or hydroxide is insoluble to all practical purposes. Sodium ferrocyanide is also insoluble, and moreover, a minimum quantity, if any at all, of this substance forms, as the absence of water removes one essential condition for its production from cyanide in the presence of iron. The cyanised briquettes from the retorts are therefore cooled and treated with liquid ammonia in suitably closed vessels under the pressure appropriate in the use of this very low boiling material. A rapid extraction is effected, and the solvent is easily driven off from the solution, leaving a mass of practically chemically pure sodium cyanide in a perfectly dry condition. The ammonia gas evolved during the removal of the solvent is recompressed, re-liquified, and re-used in the extraction process. The extracted briquettes are left in a very hard condition and can be handled in mechanical apparatus without disintegration. Moreover, the iron in the briquette is in a higher state of activity as regards its catalytic effect in promoting the cyanide reaction, and increases in value as the extraction process with liquid ammonia is repeated. Thus the use of liquid ammonia enables a pure sodium cyanide in a dry condition to be obtained from a partially cyanised briquette, containing free sodium carbonate, with the simultaneous improvement of the catalytic activity of the iron content, and ensures the impossibility of the production of ferrocyanide.

Technical Operation

A large amount of experimental and development work upon the Bucher process was carried out under the control of the United States Government Bureau of Mines, after America had come into the war. With the ever increasing demands upon the Chemical Warfare Service for the materials

for gas warfare, the shortage of cyanides was a grave possibility to be faced. After experiment had progressed sufficiently, plans were made for the erection of a large scale plant, and an excellently designed factory was available for production of cyanide at Saltville, Virginia, just as the armistice was signed in 1918. Nevertheless, it was decided to operate one section of the plant in full, and to keep close observation upon running costs, so that a true evaluation of the merits of the Bucher process could be made.

The plant was equipped with the latest labour-saving devices for the conveyance of materials, and was in every way ideal from the point of view of the inter-working of the three stages of the process. These stages may be considered as (1) the briquetting of the raw materials (carbon, sodium carbonate, and catalytic iron), (2) the retorting of the briquettes at about 950°C ., in the presence of nitrogen, and (3) the lixiviation of the cyanide from the cyanised briquettes by means of liquid ammonia.

In the first stage, a very pure coke was used, say, a petroleum coke, as any unconverted carbon is returned to the process after the final lixiviation of the cyanide. Thus a high ash coke would cause an accumulation of mineral matter in the process, which might suffer from the anti-catalytic influences of the accumulated ash. A suitable coke and the necessary quantity of iron were, therefore, ground together in a dry condition in a tube mill, so that the powder passed through a 150-mesh sieve (the greater part passing 200-mesh sieves). The necessary amount of sodium carbonate was then mixed in and the whole extruded in a wet condition into briquettes. A suitable ratio of sodium carbonate, coke and iron may be taken as 2:2:1. The briquettes were now carried to the retort house upon a mechanical conveyer, and dried by the waste heat from the retorts. Pure nitrogen was obtained from the air by means of the Claud liquefaction process, and passed over the briquettes heated to 950°C in the retorts, which were under rigorous temperature control, by means of individual pyrometers. The cyanised briquettes were cooled by heat exchange with the cold nitrogen entering the retorts.

The cold briquettes containing cyanide, unconverted carbonate, a little sodium hydroxide produced by hydrolysis of the latter, and free catalytic iron, then passed to the extraction vessels, where they were treated with liquid ammonia, under 250-300 lb. to the sq. in. pressure. The cyanised briquettes were treated in counter current method with the ammonia, and the fully extracted briquettes with their structure unimpaired, and stronger in constitution than originally, were freed from ammonia by means of a current of air. The latter containing ammonia gas was scrubbed through water and recovered. The ammonia-free briquettes were returned to the mixing house for re-incorporation into a new charge for the retorts.

The solution of sodium cyanide in liquid ammonia was transferred to evaporators, where the ammonia was recovered, finally in vacuo, leaving a fine white, almost chemically pure, cyanide. The evaporators were fitted with mechanical agitators and extrusion apparatus.

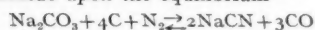
Considering now the costs and difficulties of the process, it must be remarked that the action of nitrogen upon the mixture of sodium carbonate and carbon, even in the presence of catalytic iron, is relatively slow. Thus the capital expense especially as regards retorts, is proportionately high. The output of cyanide per retort was 7.5 lb. per hour. The fuel consumption for heating the retorts amounted to 40 lb. per hour per retort, and the temperatures required, low as they are in comparison to those necessary when catalytic iron is not admixed with the charge, are such as to cause rapid deterioration of the iron retorts. Renewal was necessary about every twelve days. The labour cost involved in the replacement of retorts is not therefore inconsiderable, and delay is inevitable. Although in one case a retort was replaced by three men in four hours, it is clear that the rapid breakdown in this regard must add greatly to capital investment in the process, and to extra charges thereupon.

It is clear that a very considerable advance in the technology of the reaction of nitrogen fixation in the form of sodium cyanide was made in America during the war years, but it would be idle to pretend that the commercial production of alkali cyanide is a foregone conclusion. Many of the faults of prior processes which led to technical failure have, it is true, been eliminated. The temperature of reaction has been reduced, both by the use of iron as a catalyst and by the employment of pure nitrogen instead of producer gas, as recommended by Bucher. Hence the employment of iron

retorts come more within the bounds of practical possibilities, even in competitive normal conditions. Again the use of liquid ammonia in the extraction of the cyanised briquettes is now a proved process, and seems sufficiently economical for incorporation in a scheme of cyanide production under competitive conditions.

Nevertheless, in spite of these and other minor advantages demonstrated at the Saltville plant, there is still a grave doubt as to whether the process is capable of realisation in its present form under normal conditions. The relatively rapid breakdown of the retorts throws a great charge upon it, and the comparatively slow speed of reaction between the carbon sodium carbonate, and nitrogen increases this charge, as less cyanide is produced per retort before replacement is required. If a catalyst of greater activity can be discovered, one great difficulty would be removed.

Lack of space will not allow of the consideration of the many types of highly effective catalytic iron, produced by precipitation methods in a fine state of division in the carbon-sodium carbonate mass. Again, the exhaustive investigations of Ferguson and Maning (*Journal of Industrial and Engineering Chemistry*, 1919, p. 946) upon the influence of carbon monoxide upon the equilibrium



and, therefore, indicating the desirability of using pure nitrogen instead of producer gas, can only be referred to.

Finally, the production of hydrocyanic acid itself, by the reaction $\text{NH}_3 + \text{CO} = \text{H}_2\text{O} + \text{HCN}$ has been proved in the laboratory, and a little consideration will indicate the possible economic technical development of this process.

Physico-Chemical Problems Relating to the Soil

By E. J. Russell, F.R.S.*

FROM the earliest times soil investigators have realised that soil fertility involved both chemical and physical problems. Wallerius in the eighteenth century, Davy and Schübler in the early nineteenth and Liebig in the middle of the nineteenth century all clearly recognised this. Later on there arose a tendency to specialisation, and soil physics began to develop as a subject apart from soil chemistry; but of recent years the borderland has been explored, and it is evident that the soil investigator can be helped considerably by the physical chemist, and conversely that physical chemistry will find interesting application in soil work.

For our purpose we must look upon the soil as a complex system comprising four parts: (1) mineral particles; being disintegrated and decomposed rock fragments which, through the action of weather, water, ice and other factors, have in course of time been reduced to dimensions varying from about 1 mm. in diameter to molecular orders of magnitude. (2) Intermingled in most intimate fashion with all this is the organic matter, residues of past generations of plants and animals, which represents the source of energy for the large population of soil organisms. (3) The soil solution, being the soil water and everything dissolved therein.

Colloidal Property of Soils

These three are sufficiently obvious on mere inspection; the fourth is a matter of experiment and inference rather than of simple observation; soil possesses definite colloidal properties and therefore is assumed to possess a certain proportion of its substance in the colloidal state. Two hypotheses have been put forward: one, the older, to the effect that the colloidal properties are due to the fine particles known to be present; the other, and more recent, that they are due to a jelly surrounding each of the particles, but having a proportionately greater effect on the finer than on the coarser ones because of the difference in extent of surface. It is possible that both cases arise in nature. The difference between the two views is less than might at first appear, because the finest particles may be regarded as being distributed over the surface of the larger ones and so forming a kind of discontinuous colloidal coating.

The mineral particles of the soil are derived from rocks, and some of their constituents occur in all soils, e.g., silica, certain silicates, &c. Further, the soils under any given set of climatic conditions have been subjected to these conditions for a very great period of time, and might be expected to have attained such degree of uniformity as climatic factors can impose. It is of course true that the geological forces which produced the particles have never ceased to operate and they still continue to act, but it is also true that somewhere in the history of the soil particles great differences have arisen which no subsequent history has ever blotted out. Thus, the Lias and Trias soils are entirely different, although they adjoin and are in many places under similar climatic conditions.

* From an introductory paper presented to a conference of the Faraday Society on "Physico-Chemical Problems Relating to the Soil."

And so it happens that there are certain definite soil types which the investigator recognises by the vegetation, and which the chemist and the physicist are gradually beginning to characterise. Three general classes can be recognised: a soil may be formed from disintegrated rock, as in the Paleozoic soils of North Wales or the granite soil of Aberdeen; or, there may have been considerable decomposition; in our climatic conditions the tendency is for silica to accumulate and for the bases, including iron and aluminium oxides, to become reduced in quantity; in certain sub-tropical countries, however, the silica disappears and the iron and aluminium oxides accumulate, giving the so-called laterite soils. I have no personal knowledge of laterite soils and shall not discuss them; the other two classes, however, do occur in this country. The soils consisting of disintegrated rock material are under investigation at Bangor by G. W. Robinson, and at Aberdeen by J. Hendrick and J. Orr; while the soils studied at Rothamsted consist of decomposed rock material. So far no fundamental difference seems to have emerged in physico-chemical properties, though it is possible that there may be a difference in the colloidal matter, the disintegration soils may owe their colloidal properties to fine particles while the decomposition soils possess the jelly.

Investigations have not yet proceeded sufficiently far to enable us to say much about the jelly. A good deal of work, however, has been done on the fine particles; these can be separated from soil by simple mechanical washing. No less than 20 per cent. of the soil at Rothamsted consists of particles having a mean diameter smaller than 0.002 mm., ranging downwards to ultra-microscopic dimensions; this fraction is called "clay." The name is too old to change, but it is unfortunate. The word clay is already used in several senses; when Dr. Mellor speaks of clay he means something entirely distinct from the soil investigators' clay. Formerly there was no means of ascertaining whether or not the range of diameter was continuous, but Dr. Sven Odén has devised an elegant method by which a mass distribution curve can for the first time be obtained, thus giving the necessary information.

The clay particles possess the properties of an electro-negative colloid: their suspensions can be flocculated by addition of electrolytes; they show plasticity (though again the word is used in a sense different from that of Dr. Mellor); shrinkage; and in the mass clay can act as a semi-permeable material. The clay particles show some differences from silt.

Clay and Tilth

From the agricultural point of view the chief property of clay is its effect on the cultivation operations. A large amount (18 per cent. or over) of clay as defined above renders the soil difficult to work or "heavy"; a very small amount (4 per cent. or under) is usually associated with so low a water-retaining power that the soil becomes too liable to drought and of too loose a nature to allow of satisfactory plant growth. Between these limits lie most of the fertile arable soils of this country. With excess of clay some unsatisfactory features

set in: water is retained too strongly; the resistance to implements becomes very great; and there is a marked impermeability to air and water.

Addition of calcium carbonate modifies these properties, reducing their intensiveness and making a soil of 18 per cent of clay behave as if it contained only 12 per cent. or 14 per cent. On one of our fields at Rothamsted the draw-bar pull on the tractor during cross ploughing with a three furrow plough was 1,500 lb. on the untreated soil, but 200 lb. less on the chalked soil. Calcium carbonate therefore in some way neutralises the special clay properties. How exactly this happens is not known. Some work has been done on flocculation, but little in this country on the other properties.

Probably the most difficult problems associated with clay are those connected with tilth. Every grower knows what is meant by tilth, yet no one could give a precise definition: it can, however, be described as the capacity of the soil to assume the nice crumbly condition suitable to a seed bed. Tilth is obtained by a series of processes: first ploughing, then harrowing, then rolling to break down large lumps, then letting them dry, then allowing them to become wet by rain, then again harrowing to break them down when at the right degree of wetness. It is, however, essential to have the previous drying; by no artifice can a good tilth be obtained in persistent wet weather. Precise information is lacking, but it appears that clay containing say 30 per cent. of water may exist in two states: one if it began at 40 per cent. and dried down to 30 per cent.; the other if it began at 40 per cent. and dried down to 30 per cent.; the other if it began at 20 per cent. and was moistened up to 30 per cent. In the former case cultivation results in sticky or "poached" masses, drying to hard steely lumps; in the latter it produces a good tilth. Parallel cases could no doubt be found among the colloids.

There are other curious effects of drying which are not yet easily explicable: an enhancement of fertility, increased rate of nitrification, &c.

Some of the organic matter of the soil, and particularly the part known as humus, is sticky and jelly-like, with power of absorbing certain soluble substances. Van Bemellen directed attention to the typical colloidal properties of humus, and Baumann has developed this view. It is sufficient here to point out that organic matter exerts so great an effect that 15 per cent. or 20 per cent. obliterates the sharp distinctions between sandy soil and clay soil, and gives a new type—humus soil—having special properties of its own. In colloidal properties humus differs from clay: thus it exerts a protective effect on the flocculation of clay.

Soil Solution

Probably most of the important physico-chemical problems of the soil relate to the soil moisture or the soil solution. The water comes initially from the rain, but owing to the slowness of percolation and evaporation some is always left over between one shower and another, and this dissolves soluble material from the soil. It would of course ultimately become a saturated solution if the conditions were static, but they are always changing and so the solution varies both in concentration and in composition. Its agricultural importance, first emphasised by Whitney and Cameron, lies in the fact that it constitutes the immediate source of plant food: it is this which enters the plant root and helps in plant growth.

There is a relationship between the concentration of the soil solution and the rate of growth of the plant, though apparently not the sharp proportionality that might at first be expected. Closer examination, however, shows that proportionality would be improbable; the solution is not imbibed as a whole, and the plant needs very considerably more of the water than it does of the dissolved plant nutrients. Thus, a good crop of wheat with its accompanying straw weighs about 4 tons per acre, and transpires during its lifetime about 1,000 tons of water, i.e., 2.2 million lb. At the end of its life it contains only about 60 lb. nitrogen, i.e., 1-36,000 of the water absorbed—an amount which would be introduced by a 0.0022 per cent. of nitric-nitrogen: actually the concentration in the soil solution is of this order of magnitude, varying according to treatment from .0001 to .006 per cent. Complication arises from the fact that the plant takes up the greater part of its nutrients from the soil during its early days, so that a concentration which is appropriate and necessary at one period of its life is not suitable at another. This branch of the subject has been

much investigated, in the United States. The physico-chemical problems associated with this solution arise out of its relationships to the soil particles on the one hand and absorbent root hairs on the other; they deal with the forces with which the solution is held to the soil or the root, and the effect of the soil and the plant on its composition. It is now recognised that at least three kinds of forces are acting: intimate molecular forces of a magnitude of 1,000 atmospheres or more, capillary forces, and gravity. The pull of the plant is considerable, coming in magnitude between the capillary forces and the molecular forces. Formerly it was supposed, and evidence was not lacking, that definite transition points existed between which the soil water could be described as being in a certain definite state—the hygroscopic state, capillary state, and gravitational water. Keen has shown, however, that the evidence is faulty, and that there are no transition points and no breaks, but that the state of the water is represented by a continuous curve from saturation down to dryness: all the forces are acting all the time, though it is still true that over certain parts of the water curve one force may be more in evidence than others, thus impressing its general characteristics on the curve.

The work of Keen and of Shull affords evidence of the existence of colloids in the soil, although it does not enable us to say precisely in what form they exist. But it is clearly shown that soil differs fundamentally from a collection of sand grains, and that the existence of colloids must therefore be assumed.

Soil Particles

The qualitative relationships are more complex. Soil particles possess the power of absorbing many soluble substances from their solutions. The simplest case is afforded by organic compounds of high molecular weight, such as dyestuffs, &c. The absorption was at first supposed to proceed in substantially the same manner as is shown by colloidal substances: it was therefore regarded as an adsorption and used as a measure of colloidal material in the soil. Later work has shown that the phenomena are more complex.

Inorganic salts present greater difficulties because of the possibility of chemical reaction between some of the ions. The experimental facts are that PO_4 , Ca, K ions are absorbed, but NO_3 , SO_4 , Cl are not. Further, the absorption of inorganic ions by the soil is much affected by the composition of the soil and is quite different according as reactive calcium compounds are present or not. A distinction is made by German writers between absorptively saturated soils which contain much calcium and "absorptively unsaturated" soils, which do not: in practice the soils are distinguished by the fact that the "unsaturated" soils readily absorb the basic radicles from salts leaving the acid radicle or forming an aluminium salt and therefore causing the solution to become acid. Such soils exert a strong pull on the nutrients supplied to the plant and hence there arise manurial peculiarities which are at first sight puzzling, such as the remarkable effectiveness of calcium salts, &c. In certain special conditions the absorption or precipitation of substances from the soil solution is not general over the whole soil, but is localised, occurring at one level only. This produces a dense precipitate through which water does not readily find its way: it is known as a "pan" and it has to be broken up by cultivation before satisfactory growth can take place. Mr. Morison has studied this special case in detail.

With a little ingenuity it seems possible to explain on purely chemical grounds the difference between absorptively saturated and un-saturated soils, but the general properties of absorption show so many similarities to absorption by colloids that the action can be and has been attributed to soil colloids. Again, however, it is possible for an ingenious chemist to show (as E. A. Fisher has done) that the phenomena of absorption are explicable on purely chemical grounds. A chemist can allow himself considerable latitude, as remarkable chemical changes do go on in the soil, such for instance as the decomposition of phenol, of potassium sulphocyanide, the conversion of calcium cyanamide into urea. Undoubtedly some soil constituents are very reactive. It is undeniable that chemical changes could, and probably do, take place, but these would be quite consistent with a preliminary physical absorption. Van Bemellen's arguments seem very cogent. And if on other grounds it is necessary to assume the presence of colloids we cannot ignore them or deem them non-existent for purposes of absorption: we must take them into account.

The Present Organisation of the Alsatian Potash Mines

By J. Williams, N.D.A., N.D.D.

THE potash region of Alsace which has been under development during the past few years includes practically the whole of the country between the Vosges Mountains and the Rhine. From Colmar in the north to Mulhouse in the south the area is upwards of 124 square miles. According to recent estimates made by mining engineers, the deposits underlying this country contain approximately 1,500,000,000 tons of potash salts equivalent to 300 million tons of pure potash (K_2O). This amount is almost 300 times the annual pre-war consumption of the whole world.

For the most part these deposits belong to the middle Oligocene of the Tertiary period. Various theories have been put forward to account for their formation. In most cases it has been assumed that they were deposited from sea water at a time when the basin in which they are now situated was in the form of a lagoon. There is, however, every indication that these salts have undergone considerable transformations since they were first deposited. The original potash strata were probably in the form of crude compound salts, such as Carnallite, and through the action of water at various periods these primary salts became transformed to Hartsalz, and then to Kainit, and from Kainit to Sylvinit, the form in which the salts now occur. Each transformation brought about a higher concentration of potash; thus from Carnallite which contains only 8 to 10 per cent. of potash, the various changes ultimately produced Sylvinit, containing from 15 to 25 per cent. of potash. Sylvinit is therefore richer in potash than any of the other salts, a quality which makes it of the highest economic value.

In chemical composition Sylvinit consists of a crystalline mixture of pure potassium chloride, known as sylvin, and sodium chloride, together with a small amount of magnesium chloride and calcium sulphate. According to the analyses of the French Bureau of Mines the crude Sylvinit contains on an average 19.80 per cent. of potash (K_2O). As compared with the German crude potash salts mined at Stassfurt before the war it has a higher percentage of potash and much less moisture.

Sylvinit occurs principally in deposits of a bright red colour, with alternate red and grey bands. The reddish layers generally contain a slightly higher percentage of potash than the others, but on the whole the colouring is not an indication of the quality. The various colours are merely the result of the dissemination of a small amount of iron in definite layers.

For the mining of these deposits in Alsace shafts have been sunk to depths varying from 1,500 to 3,000 feet, according to the position and thickness of the underlying strata. As the potash beds lie almost in a horizontal plane, with only a few faults throughout their entire extent, the galleries and saps constructed in the mining operations extend in a uniform level from the bottom of each shaft, or with only slight gradients of not more than 20 to 30 degrees. The mining of the salts from the Alsatian mines is consequently less expensive than in the older potash mines in Germany, where the strata are mostly at steep angles and at much greater depths. The Alsatian deposits are also advantageously situated between impervious layers of clay and shale which effectively protect them from the inflow of water and allow of the extension of the workings under comparatively dry conditions.

The potash beds consist of two main strata separated by about 65 feet of rock salt and shale. The lower bed is from 11.4 to 13 feet thick, and contains from 15 to 20 per cent. of potash, while the upper bed has a thickness of about 3 feet 9 inches and yields from 17 to 25 per cent. of potash. Most of the potash salts now being extracted from the Alsatian Mines are obtained from the lower bed. The upper deposit has been worked in a few places only and is generally held in reserve for future operations. The whole of the Alsatian potash field has been divided into uniform concessions to be operated on by different companies under the administration of a Sequestration. At present there are nineteen mines, each with two shafts in operation, and several new pits are being sunk. In most cases the area between the shafts, about 1,000 feet, is taken up by works required for the preparation and refining of the crude salts. As the original German mines, which were badly flooded when handed over after the Armistice, have now been restored to working order with new and improved equipment, the output has been more than doubled within the past two years.

The following table shows in a striking manner the develop-

ment which has taken place since the Alsatian potash deposits passed from the German to the French administration:—

				Metric Tons.
1913.	Total output in Crude Salts	....	355,341	
1914.	" " " "	....	325,880	
1915.	" " " "	....	114,358	
1916.	" " " "	....	204,474	
1917.	" " " "	....	320,131	
1918.	" " " "	....	333,499	
1919.	" (French Control)	....	592,000	
1920.	" " " "	....	1,110,000	

Being later in the field the French have had an opportunity to install more up-to-date machinery, and the co-ordination of the whole field is more complete. From an average of 3,000 workers employed in the mines and works during 1920, the total extraction for each worker was approximately 400 tons.

The following are the principal mines now operating in Alsace:—

NAME OF MINE.	In the vicinity of	LOCALITY.
Amelie I. and II.		Wittenheim
Reichsland	" "	Mulhouse
Anna	" "	" "
Reichwiller	" "	" "
Else	" "	Reiningen
Joseph	" "	Cernay
Alsace	" "	" "
Marie Louise	" "	Staffelfelden
Marie	" "	" "
Rodolphe	" "	Ensisheim
Theodore	" "	" "
Battenheim	" "	" "
Alex	" "	Feldkirch
St. Therese	" "	Meyenheim
Prince Eugene	" "	Rullisheim

The Reichsland, which is situated just west of Wittenheim, has probably better equipment for the extraction and refining of potash than any other mine in the field. During 1920 this mine was producing as much as 800 tons of raw salts and 80 tons of Muriate of Potash daily. The Reichwiller Mine, situated on the main line between Strasbourg and Basle, is also a very large mine which is rapidly growing in importance. Being situated at the principal junction of branch lines and switches from the various centres in Alsace, it is an important depot for the despatch of potash salts for America, by rail for shipment via Havre, or by rail to Strasbourg, and by barge to Antwerp or Rotterdam. It is anticipated that within a few years there will be a good barge canal from this centre direct to Havre.

A large part of the potash extracted from the Alsatian mines is exported in the form of French Kainit 14 per cent., and Sylvinit 20 per cent. and 30 per cent. These grades are simply the crude salts crushed to the consistency of fine sand. In the mining operations the salt is blasted out in large masses from the face of the workings, and the pieces are brought to the surface are then put through a crushing mill. The finely-ground salt is afterwards sifted and put up in bags.

For the production of the more concentrated qualities, Muriate and Sulphate of Potash, a refining process is necessary. In the works which have been installed at all the important mines Muriate of Potash containing 50 and 60 per cent of potash is made by the fractional recrystallisation of high-grade Sylvinit, 20 to 25 per cent.

The Sylvinit is passed in a powdered condition by means of a worm conveyor into a saturated solution of sodium chloride at a temperature of 105° to 110° C. The potassium chloride of the Sylvinit is thereby converted into a solution, while the sodium chloride contained in it becomes precipitated. For the re-crystallisation process, the hot saturated solution of potassium chloride and sodium chloride is run off from the dissolving tanks into decanting vessels. Here it remains for about six hours, during which time the temperature is allowed to fall to 70° C. After certain impurities have become deposited, the solution is drawn off into crystallising tanks where it is allowed to cool slowly for two or three days. The Muriate of Potash is then obtained in a crystalline form along the sides and the upper part of the crystallising tanks. On being scraped from the tanks it is dried in cylindrical revolving ovens. In these ovens hot gases absorb the moisture, and the Muriate

of Potash is ultimately delivered in a dry, crystalline condition. The manufacture of Sulphate of Potash entails a much more costly process, as it necessitates the treatment of the Muriate of Potash with Sulphuric Acid. Suitable plant has, however, been erected under the control of the Alsatian Mines, and a fine grade of sulphate of potash averging 90 per cent. purity is now being produced at the following centres:

	Output per Month.
Port-de-Bouc	146 Metric tons
Quevilly	145 " "
Balaruc	145 " "
St. Fors	270 " "
Chauny	180 " "
Montargis	145 " "
Wasquehall	145 " "
Tessenderlo (Belgium)	325 " "

Potash in Compound Fertilisers

By G. A. Cowie, M.A., B.Sc., A.I.C.

It is being gradually realised by both the practical and the scientific man that extensive areas of soil in each county have become less productive, largely through the prolonged suspension of potash manuring. Potash deficiency in the soil has been manifested in various ways. Failure of clovers in the last year or two, even on heavy land, has been definitely traced to this factor, but another marked symptom has been the lack of vigour and the susceptibility to disease shown by crops in various districts. Last season the beneficial effect of potash in mitigating the attacks of mildew on turnips was observed at various centres. Another striking proof of the abnormal lowness of the potash content of certain soils is the remarkable effect which potash dressings have recently had in increasing the crop yields. In some of the official experiments on potatoes last season a dressing of potash in the absence of dung has actually more than doubled the yield, while even with 15 tons dung the addition of potash to the phosphatic and nitrogenous dressings increased the crop yield by no less than 4 tons per acre.

With a growing mass of evidence of the above kind as to the urgency of potash dressings to restore soil productiveness, it is regrettable that compound manures, which probably constitute the basis of the bulk of artificial manuring, do not generally show higher percentages of potash. Potato manures showing only 2 per cent. potash are still being offered—often admittedly alongside one containing more—but even under normal conditions, from the efficiency point of view, it is difficult to justify a potato manure for main crop varieties containing less than 8 per cent. potash. Applied at the rate of 10 cwt. per acre, which is generally more than is actually used, a manure containing 8 per cent. potash would only supply potash roughly at the rate of 1½ cwt. sulphate of potash per acre. Even with ten loads of dung per acre this dressing of potash would pay in most soils and especially in certain seasons. A type of official result obtained last season, of which I am not in a position yet to publish the source, but which strengthens the above argument, may be given as follows:

Nitrogen and phosphates	5 tons 3 cwt.
Ditto Ditto plus 50 lb. potash 6 ..	10 "
Ditto Ditto plus 100 lb. potash 8 ..	" "

When it is realised that 12 tons of potatoes take up in tubers alone 153 lb. pure potash, of which 10 tons dung will supply at the most only 90 lb., it is easier to appreciate the necessity for liberal supplementary potash dressings to secure high yields.

The strengthening of mangold manures in potash is also an urgent desideratum. The Rothamsted experiments have thoroughly demonstrated its specific value, both in increasing the crop yield and as a safeguard against disease.

Similarly in the Cockle Park experiments, the omission of potash in the artificial dressings, used even along with 12 tons dung, has resulted in a decrease of yield of 2 tons 17 cwt. per acre on an average of eleven years. A 30 ton crop of mangolds removes in roots alone 300 lb. pure potash. This certainly indicates the necessity for liberal dressings of potash even to supplement heavy applications of dung.

A common mistake in the manuring of mangolds is to be too lavish with artificial nitrogen. This tends to produce soft watery roots of bad keeping qualities. The addition

All the potash mines in the Alsatian field are provided with large storage houses, loading platforms, adjustable screw conveyors for loading in bulk, and bagging machines. For export most of the salts are put up in bags and sent by rail to the port of Strasbourg. Here the potash is transferred to the lighters which take it via the Rhine to Rotterdam or Antwerp, but in order to reduce the mining costs the Mines Administration are now drawing up plans for the building of a canal to connect Strasbourg with the Mines.

It is evident that the French people are fully alive to the importance of their potash mines. Since the war they have developed vigorous organisations for the extension of the trade in Great Britain, the Colonies, and the United States, and it seems probable that they will in time control many important industries depending on the potash supplies.

of more potash in the artificial dressings would counteract this bad effect as well as tone up the crop in other respects. It would be difficult from the experimental evidence to justify for general use a mangold manure containing less than 5 to 6 per cent. pure potash, which would really be no more than an application of 1 cwt. sulphate of potash per acre.

Similar criticism might be levelled against manures for other crops. In making a turnip or swede manure it is a vitally important point whether it is to be used in the presence of dung or alone.

The Leeds University experiments on swedes grown without dung show an increase in crop of 4 tons 9 cwt. per acre on an average of four different soils and no less than 11 tons 10 cwt. on a chalky soil from the addition of potash. In many districts turnips receive no dung; consequently turnip manures sold for general use in such cases should show at least 4 to 5 per cent. pure potash.

Where the artificial manuring is confined to turnips, as it often is under certain farming conditions, the turnip manure should contain a higher percentage of potash than the above, even for use with dung, in order to restore the total amount of potash abstracted from the soil in the course of the rotation.

The usual deficiency of potash in sandy, gravelly and chalky soils should also receive more consideration in making up manures which are to be used in such districts, and especially for the crops mentioned above as well as for clover and leguminous crops generally. Where the potash balance in the soil is not made up, it not only means relatively lower crop yields, but also the wastage to a large extent of the nitrogenous and phosphatic dressings. It is at least certain that the only scientific objection to compound fertilisers would be removed by a more judicious balancing of the fertilising constituents to suit different types of conditions.

American Coke Oven Practice

On January 14, Mr. A. H. Thwaites presided over a meeting of the Northern Section of the Coke Oven Managers' Association, in the King's Head Hotel, Darlington, when an informal discussion took place on "American Coke Oven Practice." Mr. A. H. Middleton, who, with Dr. G. Lishman, has recently returned from a tour in the United States, said that they were all aware that practically all ovens in America were built with silica walls. Their ovens were much larger than British ovens, the Semet-Solvay being about 12 ft. high and the Coppee about 10 ft. high. They were also longer, being about 40 ft. from buckstay to buckstay. The coking chambers were about 38 ft., and invariably they had the plug type of door cutting off 9 in. from each end. They were, however, narrower than in British practice, varying from 15 in. to 18½ in. The carbonising temperatures were invariably high, on an average being 250°C. higher than in England. The carbonisation period, instead of being from twenty-eight to thirty-two hours, was from fifteen to nineteen hours, and at one period the carbonising for a 16 in. oven was as low as twelve hours. The average temperatures were now, he believed, about 1,250 to 1,350. He did not come across anything in America higher than 1,350, and did not think there was anything lower than 1,250.

The Manufacture and Uses of Lime Products

By N. V. S. Knibbs, B.Sc., F.C.S.

LIME is one of the most important of chemical reagents. From time immemorial it has been employed as a base or caustic in chemical and other industries, and an account of the process of burning is given by Pliny. To-day it is difficult to name a large industry which does not use lime either directly or indirectly. It plays a fundamental part in the growth of the food we eat, in the construction of the house we live in, in the preparation of the clothes we wear, and in the manufacture of the paper from which our books, newspapers, &c., are made. In the sphere of chemical industry it is used in the alkali, bleach and ammonia industries, in water purification, in the manufacture of leather, paints, greases, glass, ceramics, sugar, paper, and in numerous other branches.

Although the burning of lime is one of the most ancient of chemical industries, until recently there was little evidence of scientific advancement in the methods employed, and even to this day there are many kilns in operation almost identically the same as those used 500 years ago or more. When wood became scarce it was replaced by coal as the source of heat, and the mixed feed kiln was introduced as being most suitable for the new fuel. Whilst this change effected an economy in the fuel consumption, the quality of the lime produced suffered deterioration due to the high flame temperature of coal and to the admixture of coal ash with the lime. In spite of these disadvantages, however, coal firing with mixed feed is used by the majority of lime burners in this country, and consequently the quality of most of the lime produced is poor. The more advanced lime burners employ a system of feeding limestone and coal which keeps them as much apart as possible, so that with careful sorting of the discharged lime a fairly clean product may be marketed, but it is impossible to eliminate completely the inherent defects of the system.

Firing by exterior furnaces attached to the kilns is an improvement in that only the hot produce of combustion came in contact with the lime, but fine ash is always liable to be carried into the kiln and very high furnace temperatures are necessary for efficient burning. Such kilns are not used much in this country.

The only type of firing which reproduces conditions approximating to those of wood is that in which producer gas is employed. By suitable regulation of the primary and secondary air supply a long, comparatively cool, flame can be maintained and all chance of contaminating the lime with ash is eliminated. Furthermore, the control of temperature within narrow limits when using gas is perfectly simple whereas with the other methods described it is almost impossible. For these reasons gas-fired kilns produce a purer and better lime than any other type, and, without question, the time will come when practically all lime for chemical purposes will be burnt by this method. At present there are very few such kilns in operation in the United Kingdom.

Limestone, of course, varies greatly in purity, and the lime made from it varies in a corresponding degree. Impurities always act as useless diluents and are frequently actively injurious in the process in which the lime is used. It must be remembered, too, when judging a lime by its analysis, that the impurities are usually combined with the calcium oxide and render an equivalent quantity of it inactive, and therefore the available calcium oxide in an impure lime may be very much less than the percentage CaO returned in the analysis.

Lime varies considerably in its chemical reactivity. An impure lime would naturally be expected to be less active than a pure one, but there is often a marked difference between limes of practically equal purity, and this must be attributed to a structural and physical difference in the material. The rate of hydration is a measure of the chemical reactivity of a lime and it may conveniently be measured by observing the rate of rise of temperature on slaking lime with water in a calorimeter.

For most purposes lime is used in the form of a suspension of the hydroxide in water, but there are several instances, notably in the manufacture of bleaching powder, where the dry hydroxide powder is employed. Here it is of the utmost importance that the particles of solid hydroxide should expose as large a surface area as possible. The exposed surface area

is proportional to the fineness of division of the powder, but it also depends upon the shape of the particles. The weight per unit volume serves as an indicator of the surface area, these two quantities varying inversely.

The hydration of lime is carried out by adding the correct quantity of water to quicklime in an apparatus which provides agitation and prevents overheating. In the past it has largely been carried out by hand, but mechanical hydrators are now available, and if of correct design they produce a hydrate of superior and more uniform quality than that made by hand.

It must be confessed that the manufacture of lime products has been carried out heretofore by haphazard methods with unskilled supervision, and it is regrettable that an industry of such natural importance should have been so neglected. In America there are many large plants which have been built and are operated on a scientific basis, and it is encouraging to note that a start has been made in this country on similar lines. In your issue of June 23, 1921, mention was made of the pioneer work of the Callow Rock Lime Co., Ltd., at their works in Somerset, and it is of interest that their efforts have been so successful that they are now largely extending their plant. It is claimed for their new gas-fired kilns that they are an advance on any other in the world.

Scientific methods under skilled technical control must eventually prevail, and we may confidently look forward to the time when lime burning will be clearly recognised to be a chemical process requiring the same skilled supervision as, say, the production of that other important base, soda. Lime will then be marketed as a standard article of guaranteed purity, and the manufacturer who has not the facilities for turning out a uniform product, and for checking its quality by constant analysis, will realise the imperfection of his products for chemical purposes.

Radium Mining in England

CONSIDERABLE interest has been aroused in Cornwall by the news that a financial group has decided to resume mining for radium at the Tolgarrick radium mine, near Truro. The mine is owned by Radium Ore Mines, Ltd., and is said to possess two rich loads of uranium ores. The work of operating the mine was abandoned during 1914 owing to the outbreak of war, but the necessary machinery had already been installed, so that there is likely to be a general resumption of activities almost at once. Interviewed by a Press representative, Mr. Reginald F. Cheux, chairman of the company, said there was little doubt that Cornwall was the world's storehouse of radium.

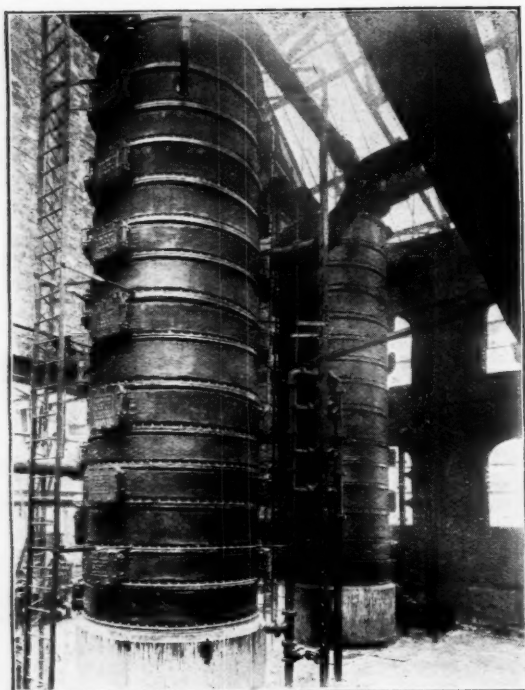
China Clay Corporation Debenture Holders

IN the Chancery Division, on January 19, Mr. Justice Sargant decided a question affecting the China Clay Corporation, Ltd., and its debenture-stock holders. The matter arose in an application by the company to disallow a certain amount of interest certified by the Master to be due to the holders of the debenture stock. By a modification of the original trust deed securing the debenture stock it was provided that interest accruing after June 30, 1916, and during the remaining period of the war on the authorised issue of £40,000 should be payable only out of the profits, if any earned by the company during such remaining period of the war. The property of the corporation had been sold and realised a surplus of £7,000, and the question for the judge was whether as regarded the period of the war the interest on the stock was to be paid out of the proceeds of realisation or whether under the terms of the modified trust deed there was no interest payable during that period because during that period no profits were earned by the company. His Lordship, after hearing counsel for the company and for Mr. Mallaby Deeley, representing the debenture stock holders, held that the words in the deed "if any," as applied to profits must clearly denote that if there were no profits no interest was to be paid, and that the profits so far as earned were to be the only source for payment of that interest. His Lordship therefore disallowed the interest accruing from June 30, 1916, to July 16, 1920, being the date of the later of the two Orders in Council terminating the war with Germany and Austria respectively.

Glasgow Corporation Gasworks

The New Sulphate of Ammonia Plant

THE by-product works attached to the different gas works owned by the Glasgow Corporation Gas Department were until comparatively recently leased by the Corporation to private traders, but about three years ago when the leases expired these works were taken over by the Corporation, and are now operated by a department known as the Chemical Works Department, under the supervision of a general manager,



THE STILLs.

Mr. W. A. Walmsley. Mr. Walmsley is in complete control of these by-product works, and since taking this in hand has largely remodelled them. An immense amount of labour has been involved in bringing the various works up-to-date. At the Provan Chemical Works it is understood to be Mr. Walmsley's intention to deal with the refining of most of the by-products, and for this purpose up-to-date plant is being installed which will render this particular works the last word in works of this order.

A large sulphate plant for the Tradeston Chemical Works, on the south side of the city, was built by Ernest Scott & Co., Ltd., engineers, of Glasgow, and the same firm are responsible for the sulphate plant at the Provan Chemical Works. This consists of two large units, both of which are now in full operation, and each of which is capable of producing 20 to 24 tons of sulphate of ammonia per day. There are certain features of these plants which will be of interest to the readers of THE CHEMICAL AGE.

The stills are of the cylindrical type. Each still section has a tray cast directly into it and formed in this cast iron tray are the gas up-takes and the liquor down-takes. Each section is fitted with three large manhole openings with swing doors, giving access to the serrated covers or "crocodiles" secured above the gas up-takes. These serrated covers are in mild steel and are so arranged that they may be removed by means of a quick-fitting attachment without the workmen having to enter the still. The serrated covers, being in steel, may be cleaned very quickly without risk of fracture, while the liquor down-takes are so situated in the sections as to be accessible through openings for cleaning purposes.

The milk of lime is introduced about the middle of the still at a special liming section, which is deepened, while the top section of the still acts as a baffle against entrainment or

priming. The discharge of the spent liquor from the still is automatic, being controlled by a special seal arrangement.

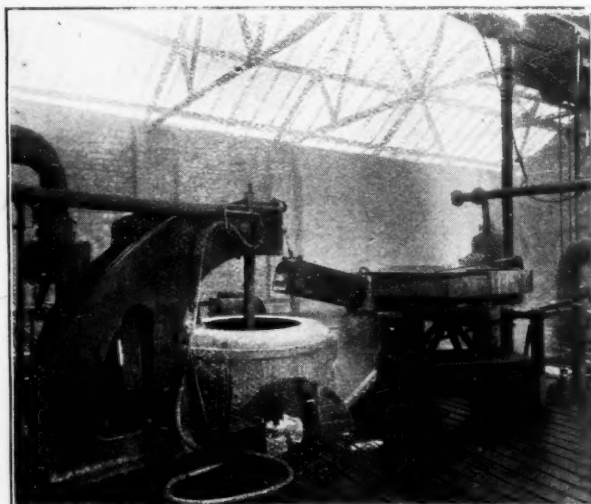
Each unit is fitted with two large preheaters so arranged that the cold raw liquor is caused to circulate through both in series. The efficiency of these heaters is such that no water is called for for the condensation of the aqueous vapour in the foul gas, the raw liquor effecting the condensation completely, and being itself raised to a temperature very closely approaching that of the foul gas prior to the liquor entering the ammonia still.

The saturator is of the open type, designed for the use of arsenical or non-arsenical acid. The sulphate is discharged in the usual manner by means of a steam ejector on to a special draining table from which it gravitates into a steam-driven hydro-extractor. The mother liquor from the draining table flows into a small receiver which also serves for the collection of the drainings from the hydro-extractor, and from this receiver the mother liquor is returned direct to the saturator. A special hot water heating system is provided for washing the sulphate in the centrifugal, and for furnishing hot water to any part of the plant when necessary. There is no accumulation of mother liquor, but provision is made for the collection of the washings on the lead-lined floor all round the saturator, these washings being returned to the saturator in the usual way.

The operating floor around the saturator is at the level of the top of the saturator. The hydro-extractors are mounted on this floor and are of the "Watson Laidlaw" steam driven type. From the hydro-extractors the sulphate is discharged directly into two scraper elevator conveyors, or is passed to the neutralising plant installed underneath the saturator platform. Finally, the sulphate is delivered into the sulphate store in a dry neutral form.

The pump house is a very complete one, each unit having its own range of raw liquor, devil water, and milk of lime pumps, and these pumps are so arranged as to be interchangeable. They are of the three-throw belt-driven type, and all the connections to these pumps are placed in channels formed in the floor.

The pumps are actuated by means of steam engines in duplicate, and an air compressor is supplied for raising the



HANDLING THE SULPHATE FROM THE SATURATORS.

sulphuric acid to the acid storage tanks placed outside the building.

Each unit is capable of producing 20 tons of sulphate per day, and is operated by two men on each shift.

Steam is supplied from Babcock boilers, the steam for the still being reduced to a suitable pressure. A steam receiver is also furnished for the reception of the exhaust steam from the engines which in turn is utilised in the ammonia stills.

The plant is in every respect designed to secure the utmost fuel economy while calling for a minimum of labour in operation.

Scientific Research and Agriculture

German Remedies for Pests and Disease

DURING the last seven years (a correspondent writes) science has been largely applied as an instrument of destruction. High explosives, poison gas, submarines, air craft, and propaganda have dealt out death and devastation upon a gigantic scale. Much of the youth of the world has been immolated and maimed. The fairest fields of Europe have been drenched with blood instead of being blessed with corn. For all this, science owes a great debt of reparation to humanity. If by successfully applying her illimitable resources to the arts of peace and by concentrating research upon production and construction science can now help ravished and depleted nations back to progress and to plenty for man and beast, she will render imperishable service in rehabilitating the world. It is fit and proper that such a movement should emanate from one of the chief centres of scientific application. Anyone acquainted with the vast works of the well-known firm of Friedrich Bayer & Co. of Leverkusen, near Cologne, will know that an enterprise started there would not be entered upon without reasonable prospects of success. Pharmaceutical medicine and photographic chemistry have already been enriched and almost revolutionised, whilst dyes and colours have been produced to match the rainbow's varying hues.

Now the effort and intention is to accomplish from the same works a similar service in the wide and fertile fields of agriculture, horticulture, and floriculture, to increase the fruitfulness of the orchard, and to make the world's harvest more uniformly commensurate with the world's increasing needs. It is not inappropriate that, allied to this enterprise and arising from the same agricultural department, there should be a concurrent effort first to diagnose scientifically the cause of diseases in domestic animals, and then to discover and apply the appropriate scientific antidotes and remedies. The alleviation and prevention of suffering in dumb animals is a suitable accompaniment to the combating and extermination of agricultural pests and diseases.

For some years past the Bayer Co. have used a preparation of quicksilver (Mercuric Phenyl-Chloride) for experiments in treating or pickling seed grain and seed-stuffs to secure as far as possible immunity from pests and disease. After exhaustive and elaborate trials an effective compound has been produced under the name of "Uspulun." This has been used upon an extensive scale for all corn crops with marked and striking success. Not only has it effected the greatest degree of immunity yet attained, but at the same time has improved vitality, promoted creative power, and increased harvest results. Other "pickling" mediums, whether sulphate of copper, formalin, or sublimate, all secure a less degree of immunity and at the cost of diminishing instead of increasing germinating power. The basic idea is to secure immunity from disease and pests and at the same time to impregnate seed with the energy which has hitherto been applied externally at later stages of growth.

"Uspulun" is now being introduced into the United Kingdom along with the other products of the Bayer Co.'s agricultural department. These products should receive the serious attention of all scientific agriculturists, especially as it is understood that quantities will be available for free trials and reports.

In addition there appear to be several sulphur preparations already available such as "Solbar," for combating and destroying noxious diseases and pests in fruit culture and horticulture, including all serious blights, such as rose blight, apple blight, and vine oidium, Monilia in stone fruit, peach curl and scab (*Fusicladium*) on apples and pears.

It is claimed for another compound, "Venetan," that it rapidly exterminates plant lice on garden, greenhouse, and field products; also that this is done without injury to the plants or prejudice to the flavour of the fruit, tomatoes, or vegetables treated, and American blight is said to be unfailingly removed by "Ustin."

The extermination of "bugs and their brood" does not sound a very alluring sport, but if "Certan" acts here as it has acted elsewhere and quickly cleanses all places where this plague appears, great masses of people will be relieved and grateful.

One great advantage of these agricultural remedies is that they are supplied in very convenient and portable packages. They are mainly in a pulverised powder form and in a highly concentrated strength. It is understood that other products

will be forthcoming in due course, and it may be confidently predicted that in the near future these compounds bearing the Bayer cross will be widely known and generally used in the agricultural and allied industries.

Sulphate of Ammonia Position

By F. C. O. Speyer

THE aim of the British Sulphate of Ammonia Federation, Ltd., is to increase the market for sulphate of ammonia, both at home and abroad, and to deliver sulphate of ammonia in the best possible mechanical condition. It is our desire also to maintain a steady level of price, leaving a reasonable margin of profit for the producer, rather than to endeavour to force up prices unduly and thus provoke the inevitable reactions which we believe in the long run to be in the interest neither of the producer nor of the consumer.

Before the war, sulphate of ammonia, although a well-known and popular fertiliser abroad, especially in tropical countries, was very little known in the United Kingdom, and the pre-war consumption here was estimated at not more than 50,000 tons per annum for agricultural purposes. During the war, therefore, when it became necessary, in order to conserve the food supplies of the country, for greatly increased quantities of nitrogen to be used, and at a time when supplies of nitrate of soda were required for military purposes, we were faced with a difficult task. The farmers were not accustomed to using heavy dressings of nitrogen and they knew very little about sulphate of ammonia. By means of suitable literature and through personal contact with as many farmers as possible, and also by arranging ocular demonstrations throughout the country we succeeded in convincing farmers that sulphate of ammonia was fully equal to, if not better than, other nitrogenous fertilisers, and as a result the consumption for agricultural purposes increased during the war to not far short of 300,000 tons per annum.

Our experience in foreign countries has been that when the conditions are suitable farmers always prefer to keep to sulphate of ammonia in preference to other fertilisers at anything like a reasonable price, and now that other nitrogenous fertilisers are once more getting plentiful we are finding the same thing happening in this country. We are, therefore, not disposed to fear the competition of any of the new forms of nitrogen which have been put on the market during the past few years.

We are of opinion that in course of time the world will require all the nitrogen that can be produced, and that the utility of sulphate of ammonia is so universal for agricultural purposes that there will be no difficulty in disposing of the quantities likely to be available.

At the present time, the production of sulphate of ammonia throughout the world has been greatly reduced owing to financial and industrial difficulties, and as far as we can see, producers will have no difficulty in selling their output at the same level of price as other nitrogenous fertilisers.

German and British Dye Industries

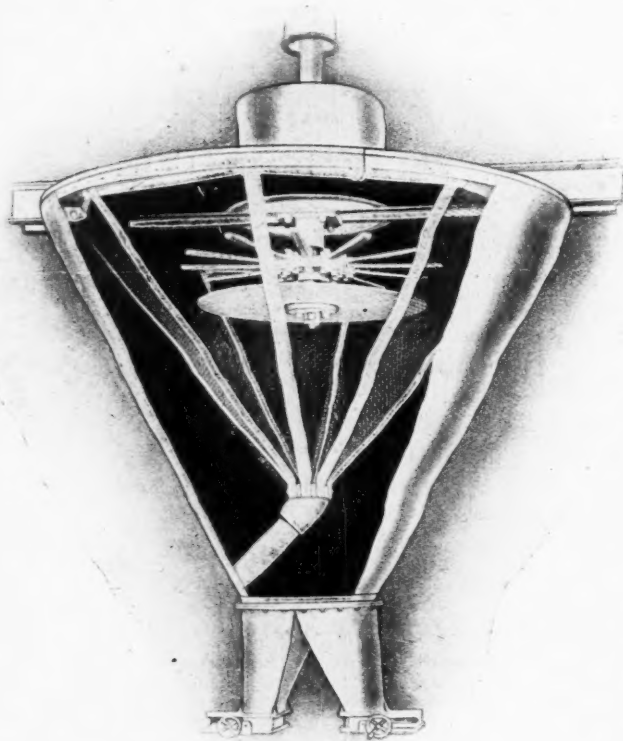
ON Monday, January 24, Professor G. T. Morgan delivered his presidential address to the Birmingham University Chemical Society. He referred to the establishment on a modest scale of the dye industry in England and France, and said the German colour industry was founded somewhat late, but owing to the closer co-operation of science and industry expansion occurred more rapidly in Germany and Switzerland, with the result that by 1914 the supremacy of these centres of industrial chemistry was unchallenged. The industrialisation of indigo was cited as a classical example of the self-sacrificing team work, by the aid of which the great German colour firms secured the trade in alizarine dyes, direct cotton colours, sulphur dyes, and the entirely new vat dyes discovered at the beginning of the twentieth century. The war showed that the German dye factories were potential arsenals for the mass production of high explosives and of poison gases, inasmuch as the latter toxic materials were almost entirely manufactured by the colour works. After surveying recent developments in this country, the lecturer emphasised the educational importance of the dyestuffs industry, which in its evolution abroad had proved a potent factor in the development of German chemical industry. Only by close attention to the synthetic chemical industries could the British Empire be rendered self-reliant in regard to the exploitation of all its chemical resources.

Blenders for Fertilising Compounds

The Elimination of Pasteing

It has been found in the breaking down of lumpy materials before mixing that there is a tendency for the material to paste if treated with certain types of blenders. In order to obviate this a machine known as the "Pulver" blender has been designed for the treatment of superphosphates, special manures, and other chemical compounds. The apparatus, which is illustrated below, is said to eliminate pasteing, while combining the operations of breaking, mixing, blending, screening, and bagging materials fed to it. In order to give a clear view of the rotating parts certain portions of the interior of the apparatus are omitted from the illustration.

The only rotating parts are the beaters which do the breaking, and the intercepting plate, which catches any small particles that miss the beaters, and projects them against the screens. This ensures that everything entering the machine passes over the screens. The outer casing of steel plate provides storage capacity for the blended and screened products, which are bagged off below. Control of the outlets



THE "PULVER" BLENDER.

is governed by automatic swing or sliding doors. The opening of these doors distends, supports, and holds up the sacks whilst being filled. This device eliminates the use of straps or the tearing of the sacks by hooks. The screens are laid in the panels to facilitate removal and the insertion of clean screens. The stoppage for the insertion of clean screens involves, it is claimed, a matter of minutes only as against hours involved in cleaning an ordinary mixer. It is further claimed that the power required for driving is less than half that for machines capable of a similar output. The tailings are practically negligible, and the whole apparatus is dust tight. It can be supported by beams from above, thus economising floor space.

The "Pulver" blender, which is manufactured by the Bickle Engineering Co., Ltd., of Plymouth, is made in three sizes with capacities of from 2 to 4 tons, 8 to 12 tons, and 15 to 20 tons per hour.

Nitrate Stocks and Shares

A Tabular Comparison of Values and Dividends

The market for nitrate shares remains a very quiet one, although, as was pointed out in our columns a few weeks ago, the prospects of an improvement in the statistical position of the product are fairly favourable. While above the lowest prices of last year, present share quotations are very considerably below the highest touched in 1921. In the following table are contrasted, in respect of fourteen leading companies, the present prices of the shares, the highest and lowest prices touched in 1921 and 1920, and the dividends per cent. paid for the last two years. The shares are of £1 each, unless otherwise stated. In the case of the Anglo-Chilian, Lagunas, Liverpool, London and Santa Rita companies, dividends are paid net, or free of income tax, which, with the tax at 6s. in the pound, increases by three-sevenths the actual amount distributed.

	Last Year.	Pre- vious Year.	Market Price of Share.	1921.		1920.	
				High- est.	Low- est.	High- est.	Low- est.
Alianza (£5)	60	40	13	16½	12½	25½	15½
Anglo-Chilian	25	15	35/-	37/-	35/6	—	—
Lagunas (£5)	4	2	21/-	27/6	19/3	45/-	20/-
Lagunas Syndicate ..	nil	nil	4/-	5/3	3/6	10/6	5/-
Lautaro (£5)	nil	10½	5/-	9½	4½	17½	9½
Liverpool (£5/-)	100	280	2½	70¼	48/9	5½	3½
London	7½	7½	1½	38/9	25/-	80/-	33/-
New Paccha and Jaz- pampa	8	5	1	2½	1½	5½	2
New Tamarugal	20	5	1½	26/1½	17/9	48/-	21/-
Pan de Azucar	5	5	1½	45/-	29/-	—	—
Rosario	50	40	21/-	27/7½	19/-	—	—
Salar del Carmen	15	10	1½	36/6	23/9	77/-	38/9
Santa Rita	25	5	—	27/6	21/-	40/7½	20/3
Santiago (£4)	7½	7½	1½	2½	1½	3½	2

The new Tamarugal Company, which makes up its accounts to the end of July, has already paid an interim dividend of 10 per cent. on account of 1921-22. The Salar del Carmen made, in October, an interim payment of 10 per cent. on account of the year to December, 1921, the accounts for which will not be issued until May next.

Chemical Trade Wages Deadlock

MR. ROSCOE BRUNNER presided on January 19 at a meeting of the Joint Industrial Council for the Chemical Trades, called to consider the proposals made by the employers for a reduction of wages of 3d. per hour as from February 1 next. The workers' representatives contested the employers' demand and urged that the reduction was not warranted, and even if there were grounds for a reduction then to ask for an amount equal to 12s. a week was unjust. The employers' representatives stated it was their intention to reduce wages by 2d. per hour on and from February 1, with a further reduction of 1d. per hour on March 1. The workers' side refused to agree, and the meeting broke up, the employers expressing the intention of imposing the reduction.

The Dawson Sulphuric Acid Plant

IN a modification of the chamber sulphuric acid process "towers," known as barriers, are erected inside the chamber with the object of acting as washers of the mixed gases as they pass through. Entering the chamber, the gases, coming into contact with the surfaces of the barriers, which are kept moist, set up an accelerated action, meeting a counter-flow of liquid fed from reservoirs sunk into the chamber top. Feed liquor is taken from the bottom acid chamber, and, after cooling, is run into an acid elevator. The barriers are of acid-resisting material, and the ends of the chambers are truncated or domed in order to facilitate the better distribution of gases. The process, which is claimed to be automatic, is worked by Mr. H. Royal-Dawson, of Summerfield Road, Bridlington, who specialises in plant for the acid and fertiliser industries.

Society of Dyers and Colourists

Manchester Section

A MEETING of the Manchester Section of the Society of Dyers and Colourists was held on Friday, January 20, Professor Knecht presiding, when the following papers were presented: "Some Notes on Hypochlorous Acid and Chlorine, with a Comparison of their Bleaching Action," by R. L. Taylor, F.I.C.; and "Some Causes of the Staining of Printed Fabrics, with some General Remarks on Moulds," by E. J. Sidebotham.

Hypochlorous Acid and Chlorine

MR. TAYLOR pointed out how, by using very dilute solutions, he had been able to make comparative experiments on the bleaching activity of hypochlorous acid and chlorine, and had demonstrated the superiority of chlorine with certain colouring matters. It was, he said, an error on the part of Mr. S. H. Higgins to conclude that chlorine, because it failed to bleach linen, was therefore a feeble bleaching agent, pointing out that hypochlorous acid was equally inactive in the case of the colouring matter of linen. Mr. Taylor showed a remarkable experiment on the action of very dilute chlorine water upon litmus, where the litmus solution at once turned bright red, but in a few seconds this colour changed to purple and then, if sufficient chlorine water was present, faded away. He suggested a probable explanation of this curious action, and stated that if his explanation was correct some ideas as to the mode of action of chlorine upon colouring matters would have to be modified.

MR. S. H. HIGGINS said that in the tests he had made all the results with linen were obtainable with cotton. As regards tests of turkey red and indigo he had already conceded the point that chlorine was the best bleaching agent.

MR. J. HANNAY thought they would all admit the bleaching agent was altered, and the question was which was the best intervening agent to use, chlorine or hypochlorous acid, in order to activate the oxygen? Surely, when silver nitrate was added to a hypochlorous solution, and there was a gradual decomposition, with a deposition of chloride of silver, there was freed in the solution a certain amount of nitric acid which would act as a strong oxidising agent with the hypochlorous acid left in the solution.

MISS EVA HIBBERT inquired what Mr. Taylor considered to be the best way of identifying hypochlorous acid.

MR. TAYLOR said he had devised a method for identifying hypochlorous acid in the presence of chlorine when they were in vaporous condition by passing them through a solution of arseniate of silver, but he could not remember doing it in a solution.

MR. J. HUEBNER said that many years ago he suggested the bleaching of paper pulp would be a more promising field for the investigation of bleaching action, or to decide how the bleaching action actually proceeded. It was invariably found, in paper bleaching, that if chlorine was produced to such an extent that it could be smelt, the bleaching action was inferior.

DR. COWARD said that the avoidance of the production of hypochlorous acid was one of the first thoughts of the bleacher, who invariably endeavoured to work with a solution of hypochlorite. If a hypochlorite was a better bleaching agent than hypochlorous acid the main difference between the two was that the hypochlorite contained a large proportion of its OCl_2 groups ionised, whereas hypochlorous acid contained an exceedingly small proportion, and also an equally small proportion of hydrogen ions. If a weak base like alumina or ferric oxide was soluble in hypochlorous acid the salt solution, being composed of weak base and weak acid, would have very few hypochlorite ions and the examination of the bleaching properties of such solutions might throw further light on the problem. Mr. Taylor stated that chlorine was said to bleach by decomposing water, and that it was the nascent oxygen which bleached. His experiment showed that the chlorine acted on the colouring matter directly and chlorinated it. This was an important point.

MR. HANNAY inquired whether chlorinated indigo still remained blue. It should be an easy matter to decide whether the bleaching of indigo by chlorine was due to chlorination or to oxidation. MR. TAYLOR said his remarks about chlorine only applied to litmus.

The Staining of Printed Fabrics

In his paper, DR. E. J. SIDEBOTHAM described two cases of exported Manchester fabrics which were forwarded to the Public Health Laboratory of the Manchester University to

ascertain the cause of staining. One of these was found to be due to the growth of a mould which had spread from boards which had been infected with the mould and round which the printed fabric had been wrapped. In the other case, the stains were produced from hessian union, the tarry material having been exposed to the action of a tar solvent.

In the discussion MR. W. THOMSON said that hessian very often contained approximately 15 to 20 per cent. of oil. He thought it was sometimes found that the oil would dissolve the pitch and so communicate it to the cloth.

MR. HUEBNER described an investigation into the effect of mildew on metal printed fabric. The fabric had become quite tarnished, but the tarnishing began at the wrapping board and chiefly at the edges of the board. It gradually became less and less further away from the board, and disappeared on the outside of the piece. As a rule, the packing boards were most carefully dried, but in this case damp boards had been used.

MR. HUEBNER mentioned an instance of mildew spreading on cloth dyed para-nitraniline red. The growth began at the label and spread from the label over the piece. The mildew turned the para-nitraniline blue. Another case was that of logwood black dyed on copper-chromium mordant. When the pieces were opened the black had disappeared and the colour was found to be a greyish brown. The mildew had entirely destroyed the logwood but had apparently been arrested by the metallic mordant, and therefore could not get on to the cotton fibre. The pieces were put through the logwood liquor again, when they became black. Some of the most beautiful forms of mildew growth he had ever seen occurred in the case of aircraft cloth, which had been returned from Egypt and Mesopotamia.

MR. LESTER mentioned the case of a pink mildew which had appeared on a cloth and had grown to a large spot. There was a blue colour in the centre which was apparently growing outwards and displacing the pink colouration. Another extraordinary case was that of some damp parchment paper in which every shade of the spectrum appeared.

MR. HOLDEN thought the action of logwood blacks would probably depend upon how they were dyed and the acidic action. It would be interesting to learn whether these moulds could be used for dye purposes.

THE CHAIRMAN said a Japanese patent had been taken out some years ago for the manufacture of alizarine from rice.

MR. THOMSON said he once cultivated some red mould he had found in cloth and got a crop with which he dyed silk a beautiful colour. He had done the same thing with a deep-blue mould which was developed in the form of cells only, but when he cultivated it to get a larger quantity of the blue, the colour gradually died away and the last cultures were practically grey.

In reply to Dr. Harland, DR. SIDEBOTHAM said the fungus was a destroying organism, and that a mould colony actually showed signs of breaking into the cellulose.

Transformer and Switch Oils

At a meeting of the West of Scotland Branch of the Association of Mining Electrical Engineers held in Glasgow on January 14, Mr. John A. Brown read a paper on the above subject, in the course of which he said that comparison of the different oils was difficult, but it appeared safe to say that the points in favour of oils having a paraffin base were its high flash point—especially for switchgear—its power in maintaining its viscosity and its good resistance to oxidation and sludging. It seemed to him that a high class mineral oil for use in transformers and switchgear should possess the following virtues: (1) Complete freedom from moisture; (2) high dielectric strength; (3) a flash point considerably above that of the highest operating temperature of the plant; (4) a low viscosity, especially for transformers; (5) a low freezing point, particularly for switchgear; (6) complete freedom from alkali and acid; (7) a low evaporative loss; (8) freedom from tendency to sludge; and (9) absolute freedom from sulphur.

Dr. Duisberg's Visit to U.S.A.

It is reported that Dr. C. Duisberg, general director of Friedrich Bayer & Co., of Leverkusen, Germany, is about to leave for the United States of America on business connected with the Bayer patents.

Institute of Chemistry

Huddersfield Section

AN ordinary meeting of the Huddersfield Section of the Institute of Chemistry was held in the Queen's Hotel, Huddersfield, on January 16, Dr. H. H. Hodgson in the chair. It was announced that Dr. Paul had consented to serve on the committee in the place of Mr. H. W. Moss, resigned. An invitation was received from the Society of Dyers and Colourists, Huddersfield Section, to meet with them on February 10 at the George Hotel, when Dr. Hodgson was to deliver an address on "Suggestions for a Research Policy"; this invitation was accepted.

Technical Education in Chemistry.

Dr. H. H. Hodgson then delivered an address on Technical Education in Chemistry, with special reference to the new scheme of co-operation between the Board of Education and the Institute. He opened with some general remarks on technical education which, he stated, must generate enthusiasm and cultivate the imagination; this result could only be reached by incorporating research work in any organised course of technical education. The required type of teacher would then be obtained. Technical education differed widely from secondary education and demanded a different kind of teacher. A brief sketch was given of the history of technical education from its early days under the Science and Arts Department and financed by the "Whiskey Tax," to the present day. The early scheme did attempt to award certificates which represented the same standard of merit at whatever institution they were gained, but at present each college awarded its own diplomas with corresponding variations in standard. The scheme of co-operation between the Board of Education and the Institute of Chemistry did, he said, attempt to ensure in chemistry, at any rate, an uniform, national standard of proficiency for the certificates awarded. The scheme was then described.

Students are required to produce evidence of having reached a satisfactory standard of general education and may then engage on a full-time course which should nearly equal the requirements of an honours B.Sc. degree, or they might undertake one of two part-time courses. In each case diplomas are to be awarded by the Institute, which has extensive powers of examination into the student's record, and part responsibility for the final examination for the diploma. These diplomas are to be clearly differentiated from those awarded for the associateship of the Institute. The chairman stated that in his opinion the scheme was a very good beginning, and he hoped that it would lead to further reforms. The standardisation of diplomas was a very necessary step, and he hoped that the scheme would lead to a revival of research in technical schools. The importance of this was emphasised by the late Professor R. Meldola in his Presidential Address to the Chemical Society in 1907. Where no research was done, ordinary experimental work generally languished and the teaching of chemistry without full experimental illustration was, he felt, almost profitless.

Discussion

After an interval, a discussion took place, to which the following contributed: Messrs. H. S. Foster, S. Robsin, C. W. Taylor, R. O. Eames, G. B. Jones, J.P., Butterworth, E. W. Holmes and the secretary. The necessity for such a scheme was called in question by several speakers, who held that the external degrees of London University already provided suitable diplomas for students working at technical colleges. It was feared that the holders of these new diplomas might be regarded as fully trained chemists by many employers and any deficiencies in their work laid at the door of the Profession as a whole. Others, however, held that the technical school student was often more thorough in his work than the University student. The scheme was welcomed by several because the diplomas would represent something like the same standard of proficiency all over the country and also because they hoped that it would lead to more interest in, and a raising of the standard of scientific technical education. The necessity for providing some means by which promising students could proceed from the evening classes at technical schools to the universities was indicated. Some speakers felt that the evening classes often contained students who should have been weeded out by a suitable preliminary examination. Emphasis was also laid on the danger that parents might think that the present scheme offered a new and cheap route to the profession of chemistry with subsequent disappointment.

In the absence of the chairman, Dr. A. E. Everest brought the proceedings to a close. He thought that the ideal state would be one in which there was no necessity for part-time education or evening schools, but that was an Utopian ideal at present. The present scheme he viewed with mixed feelings—it appeared to present the Institute as a kind of rival of the external side of London University but offering easier degrees, and he viewed that with regret; in place of the present chaos of diplomas with their varying requirements in proficiency the scheme attempted some correlation: this he heartily welcomed. It was decided to renew the discussion in March.

The Nauru Phosphate Industry

(FROM A CORRESPONDENT)

THE placing upon the market of Nauru phosphate, which, under agreement with the Governments of Great Britain, Australia and New Zealand, has become available for British farmers, resulted in the formation of the Slag Phosphate Co., Ltd. This company was organised by the South Wales Basic Slag Co., Ltd., with which the well-known steel-making firms of Baldwins, Ltd., and W. Gilbertson, Ltd., of South Wales, are associated.

Under agreement with the British Phosphate Commission, the supplies of Nauru phosphate available for Britain were placed in the hands of the Slag Phosphate Co. for distribution, and the company has made a special point of supplying to agriculturists the Nauru phosphate mixed with basic slag in such proportions that grades of phosphatic fertiliser are available containing from 30 per cent. to 86 per cent. phosphate of lime.

In addition to publishing a considerable amount of information regarding Nauru and the phosphate, the company has arranged for the carrying out of experiments in some forty centres during the current season, while large numbers of farmers have purchased supplies which are being utilised in place of basic slag and superphosphate.

Notwithstanding the depressing conditions in the agricultural industry, the company's works in South Wales have been kept very fully occupied in grinding the phosphate to meet the autumn and spring demands.

Although the Nauru phosphate is supplied for agricultural purposes in Britain finely ground (that is, 80 per cent. to pass through the usual 100-mesh sieve), it is not otherwise treated in this country. The introduction of Nauru phosphate, therefore, represents the first occasion on which ground phosphate untreated with acid has been available for direct application to the soil in any considerable quantity.

Naturally, the operations of the company have been watched with much interest, not only by agriculturists but by those interested in the chemical industry, and the term "slag phosphate" which has been used for the mixture of ground mineral phosphate and basic slag has become well known as descriptive of the mixture of slag and Nauru phosphate.

One of the points strongly insisted on is that Nauru phosphate, being Imperial property, will be available for many years to come at prices which cannot be unduly advanced without the consent of the Governments concerned. The research work carried out with basic slags during the past thirty years has induced the farmer to use this material freely. Now, however, with the general adoption of the open hearth method of steel-making, the character of the basic slags available has changed, and the farmer finds himself compelled to study new sets of experiments to test the comparative value of the new basic slags as compared with the older and usually higher grade material.

Tar Distillation

At a meeting of the Newcastle-on-Tyne Section of the Society of Chemical Industry in the Chemical Lecture Theatre, Armstrong College, on Wednesday, Mr. E. V. Chambers read a paper on "Tar Distillation." The author discussed various types of tar and their characteristics, and the various methods of distillation, including the intermittent and continuous processes. Various types of plant were described and illustrated. Mr. Chambers also dealt with the distillation of tars containing high percentages of water, Mond tar, producer and water gas tar; the separation and distillation products, tar acids, naphthalene and anthracene. Samples of various tar distillation products were shown in addition to a number of slides illustrating various plants.

Scientific Apparatus and Plant

Exhibition at Institute of Chemistry

AN exhibition of scientific apparatus was held on Wednesday, from 6 to 10 p.m. in the laboratories of the Institute of Chemistry, Russell Square, London.

On the ground floor United Water Softeners, Ltd., of Imperial House, Kingsway, London, displayed the "Sharples" laboratory centrifuge which is a miniature of the commercial machine. It operates, the manufacturers state, at a speed of 40,000 revs. per. min. In addition to its normal uses it is employed in the clarifying of pharmaceuticals, in the analysis of paints, and other special applications.

An ultra-condenser, used for illuminating, ultra-microscopically, small particles while observing gases and liquids was one of the features of the display of Messrs. C. Baker, of 244, High Holborn, London. This condenser, which is capable of being easily centred, holds a comparatively large volume of liquid, so that absorption effects are minimised. Another of the firm's numerous exhibits was the Reflex drawing apparatus, which facilitates the drawing of images seen in a microscope, by projecting them on to paper, allowing the image to be traced with a pencil. The image can also be projected on to the ceiling or on the floor.

A. Gallenkamp & Co., Ltd., of 19, Sun Street, London, were showing, for the first time, The Sir Boverton Redwood Viscometer, the main feature of which is the uniformity of heating obtained. Electro-titration apparatus, which is coming into increasing use in this country, was shown in addition to a selection of glass-beakers and flasks with an outside coating of electro-deposited copper.

Stills and ovens were shown by Messrs. Brown & Son, of Alembic Works, Wedmore Street, London, manufacturers of a self-sealing autoclave. A prominent exhibit was the "Brown" patent combined still, oven and evaporating pan which is specially designed for laboratories where a variety of small drying and concentrating operations are frequent and numerous.

Chemical balances with horizontal and triangular beams, of various lengths from 5 to 10 in. were exhibited by L. Oertling, Ltd., of Turnmill Street, London. In many of these balances, the centre knife-edge is relieved when not in action. Some models were also fitted with adjustable pan supports.

H. Tinsley & Co., of Werndee Hall, South Norwood, London, showed their ionisation potentiometer in addition to the Vernier potentiometer and accessories.

Duroglass, Ltd., of 40-43, Norfolk Street, Strand, London, demonstrated a novelty which took the form of a glass water circulator and suction pump combined. This device, which is patented, will, we understand, be placed upon the market shortly.

A new aid in the olfactory examination of essential oils and compound perfumes, known as the "Evapolfactometre," was displayed by Messrs. Lautier Fils, of 4, Denman Street, London. Based on the principle that the vapour tensions of perfumes are, in most cases, different, the apparatus heats, slightly but progressively, a blend of compounded perfume. As a result of the heating, the various components evaporate one after another according to their different volatilising powers.

Doulton & Co., Ltd., of Lambeth, London, displayed various kinds of chemical stoneware, and a comparatively large-scale model of a nitric acid plant executed by the firm.

Chemical balances and a large and varied selection of scientific apparatus were shown by Baird and Tatlock Ltd.

The exhibit of Allen & Hanburys, Ltd., of 37, Lombard Street, London, comprised a new series of indicators for the direct colorimetric evaluation of hydrogen ion concentration and for titrations. The P_H indicator tablets, which were shown will, it is claimed, give direct and accurate readings between the limits P_{H4} and P_{H11} , and are applicable to highly coloured and to turbid solutions. The "A. & H." insoluble indicator is an aqueous suspension of an insoluble base in a fine state of division. The base is a complex indamine of blue-violet colour which forms insoluble salts. This indicator possesses no advantage over the soluble indicators except when recovery of the solution is desired. Such mixed indicators as methyl thymol blue; phenol violet; phenol thymol phthalein; and thymol violet were also shown.

British Burmah Petroleum Co., Ltd.

PRESIDING at the adjourned ordinary general meeting of the British Burmah Petroleum Co., Ltd., held on Tuesday, at the Cannon Street Hotel, London, the Hon. Lionel Holland said the year ended last July was one of discouragement and anxiety. The setback came with some suddenness, following three years of mounting and exceptional prosperity. In India the reaction had been very marked, but there was reason to believe that the worst of the crisis was over. Conditions in the oil industry of the world and in India had, however, materially diminished the company's profit. They were deprived of the profit on exchange, which contributed so largely to the favourable showing last year, when it amounted to over £112,000, whereas this year it was under £10,000. The collapse in industry and shipping and the curtailment of manufacturing activity had caused a severe fall in the prices of oil products, especially benzine and wax, upon which they relied largely for their revenue. In one respect, however, they were more fortunate than many oil companies, for their refinery was in the centre of a vast market for kerosene, and the price in India was less subject to fluctuation. Taking all the refinery products together, their value per unit of manufacture inevitably showed a marked decline, while the relative cost of manufacture had risen, chiefly owing to increased wages. On the other hand, there were directions in which substantial economies were being or would shortly be effected. The refinery throughput averaged 300 barrels per day less than in the preceding year, through smaller deliveries of crude oil from the producing fields and a strike in September and October among employees. The crude oil shortage contributed in no slight degree to the reduction of profit in the past year, the trading balance being £168,559, or a drop of nearly £200,000. After deducting sundry charges, debenture interest, and depreciation, as well as nearly £77,000 for drilling and sinking, there remained a profit balance of £93,334, which enabled them to pay a dividend of 12½ per cent. free of income tax.

Mr. Roscoe Brunner on Chemical Trade Prospects

SPEAKING on January 21 at the annual meeting of the Winnington Recreation Club, Mr. Roscoe Brunner, chairman of Brunner, Mond, & Co., Ltd., declared that neither he nor his late father foresaw the enormous trade slump of last year, accentuated as it was by the coal stoppage. After a short revival, when chemical manufacture was increased, there had now, unfortunately, come upon the world another slump, the length and depth of which no man could estimate. He hoped and believed there was a better state of trade coming, but depression certainly existed to-day, and since January 1 Brunner, Mond, & Co. had had to cut down at two of their works. He confessed his complete ignorance of what was going to happen, and why things had happened in the past, but he did hope and believe that within a short time there would be a considerable increase in trade done by the country, and he hoped this would be reflected in the chemical industry.

St. Dunstan's Review

A STRIKING memento of the life and work of the late Sir Arthur Pearson, particularly that portion devoted to the care of blinded soldiers and sailors, is contained in the Special Memorial Number of *St. Dunstan's Review*, which has just been published at 1s. This attractively-printed magazine forms, in its ordinary issues, a monthly record of the work and play of St. Dunstan's men all over the world, and as such is sent to them free. Issued from the Headquarters of St. Dunstan's Work, Inner Circle, Regent's Park, London, N.W. 1, it has also a large circle of subscribers amongst the general public interested in St. Dunstan's work, to whom the annual subscription is 7s. 6d.

Recent Wills

Mr. Charles Estcourt, of Seymour House, Seymour Grove, Manchester, analytical chemist, for forty-seven years city analyst of Manchester	£25,496
Mr. John Spiller, of St. Mary's Road, Canonbury, London, at one time interested in Brooke, Simpson, and Spiller, Ltd., aniline dye manufacturers, a member of the Council of the Institute of Chemistry from 1880-83	£8,815

Safeguarding of Industries Act Calcium Carbide Inquiry Concluded

THE inquiry under Part I. of the Safeguarding of Industries Act, into the request that calcium carbide should be placed in the list of taxable articles issued by the Board of Trade under the Act, was resumed on January 19, when Mr. James Swinburne gave further evidence for the opposition, and dealt with the various definitions of organic chemicals.

Dr. M. O. Forster, F.R.S., said that from his experience he did not regard calcium carbide as a synthetic organic chemical. It was, of course, a chemical, because it was produced by a chemical process; but he regarded it as an inorganic chemical as he had always held that it was one of the exceptions to the class of carbon compounds which rigid theorists called organic. It was produced in a manner which was quite different from the other 400,000 organic compounds which existed. He regarded calcium carbide as synthetic only in the purely literal sense that any substance was synthetic if it were made up by putting the compounds together. Taking the phrase "synthetic organic chemical," he had never hesitated to say that calcium carbide did not come within that definition. Never since it was first known had he ever heard anyone suggest that calcium carbide was a synthetic organic chemical until this case. It was not justifiable to call calcium carbide an open chain compound, because nobody knew what calcium carbide was. Equally he did not think it could be called a closed ring compound. He regarded the production of acetylene from calcium carbide and water as an accidental circumstance, and it was one of those apparent things which had led chemists in the past to the conclusion that it was a derivative of acetylene.

Dr. Forster did not regard calcium carbide as a derivative of acetylene nor did he regard it as an acetylide because that word was always used in relation to a particular class of substance, such as copper acetylide and silver acetylide. Beilstein was the bible of the organic chemist and he did not call calcium carbide an acetylide. It was a conceivable explanation to him that in calcium carbide they had an agglomeration of groups in which the carbon was monovalent, because it was perfectly clear that calcium carbide, which was a solid substance with a high melting point could not have a molecular structure which was simply C_2Ca . If it did, then its properties would be entirely different. Therefore, it must be looked upon as $C_2Ca_x + X$, an unknown quantity, and he regarded calcium carbide as a massing together of a number of C_2Ca units, and if they accepted that view of it, then his suggestion became perfectly practicable.

At the resumed hearing on January 20, Dr. Forster was further cross-examined by Sir Arthur Colefax, K.C., on behalf of the applicants. The question of the heating of calcium carbide was first dealt with in relation to its charring, tubes containing calcium carbide which had been heated to 350°C. for three-quarters of an hour being placed before the Referee. He agreed that he could not point to anyone who had considered the structure of calcium carbide and had put forward views such as he had done on the previous day, but new ideas were constantly coming forward in regard to this matter. As to whether calcium carbide was synthetic Dr. Forster said it could be so regarded in the scientific sense of the word. It was not synthetic in that it copied from nature or that it had counterparts in plants or animals. That could only apply to organic chemicals. The word "synthetic" had not been defined but had gradually grown into use.

On January 21 Dr. W. R. Ormandy, called as witness for the Norwegian manufacturers, said he did not regard calcium carbide as a synthetic organic chemical. All the carbides, generally speaking, had been regarded as inorganic, and he agreed with that view. It had been argued that because a thing had been made from acetylene therefore it was an acetylide, but he pointed out that quite a lot of carbides which gave acetylene were more readily made from carbon dioxide. Carbides as a class must be regarded as inorganic. He had obtained a sample of pure carbide from Norway in a sealed tin, and had taken precautions that moisture did not get at it. This had been heated in a test tube to the melting point of the glass and there was no appreciable charring. If this was examined against a sample of the carbide, which had not been heated, it would be seen that there was only a slight darkening. He agreed with the previous evidence that calcium cyanamide was inorganic, but that cyanamide was organic.

Cross-examined by Mr. J. Hunter Gray, K.C., Dr. Ormandy said he agreed in general with Dr. Forster, although there were some points on which they might not be altogether in agreement. He was convinced that calcium carbide could not be termed an organic compound. He only accepted the definition of an organic chemical "hydrocarbons and their derivatives," as an academic definition subject to exceptions; it was more a description than a definition.

Captain A. C. G. Egerton of the Clarendon Laboratory, Oxford, agreed that calcium carbide was not a synthetic organic compound. Although some people regarded it as a chemical, it could not be regarded as organic, and it certainly was not synthetic in the meaning of the term which the man in the street understood. Organic bodies were unstable in the thermo-dynamic sense, but calcium carbide was extremely stable at very high temperatures. Moreover, the calcium content of calcium carbide was by far a greater proportion than the carbon.

Mr. C. A. Hill said he had never heard calcium carbide referred to in the trade as a synthetic organic chemical.

Mr. H. Ballantyne, who was recalled by Sir Arthur Colefax with regard to the experiments which had been carried out upon the heating of calcium carbide, stated that the powdered calcium carbide which he had used had been obtained from the Spondon works of the British Cellulose and Chemical Manufacturing Co., Ltd., and had been heated to 540°C. In this case there had undoubtedly been charring and in his view the specimens which had been shown by Dr. Ormandy also showed charring.

Mr. Whitehead then addressed the referee on behalf of the Board of Trade, and submitted that the onus was upon the applicants to establish their case that the Board of Trade had made a mistake in omitting calcium carbide from the list of goods which had been issued. His submission was that on the evidence even of the complainants alone, they had entirely failed to discharge that onus. It was not open to any body of persons to dissect the term "synthetic organic chemicals." The real test here was whether or not calcium carbide was an organic substance. Various definitions had been submitted, all of which, from one standpoint or another, were easily open to criticism.

Mr. Courtney Terrell, for Messrs. Allen-Liversidge, Ltd., said it had been suggested that it was necessary to find a definition for the words "synthetic organic chemical," and then to apply it. He submitted, however, that that was entirely wrong, and that it was unnecessary to find any definition of the term before applying it. The matter could only be looked at from the point of view of the industrialist and the manufacturer, and the academic view must be cut out. The case for the applicants had been based largely on the academic view, but in his opinion the words in the schedule had no academic significance at all. The only way to look at the matter was from the point of view of the method in which the goods were manufactured, and the evidence in that respect was all in favour of the view that calcium carbide could not be regarded as a synthetic organic chemical.

On Monday, Mr. Douglas Hogg, K.C., submitted that synthetic organic chemicals were included in the fine chemical trade, and calcium carbide was not a fine chemical. The schedule, he said, was addressed to merchants and had to be construed in a commercial sense.

Sir Arthur Colefax suggested that to say calcium carbide was an acetylide meant that it had the structure in which carbon was linked to carbon by the treble bond, and he submitted that that was the universally accepted view of its constitution at the date of the Act. There might be a question for the opinion of the courts upon the principles applied in construing the Act, and he asked that the Referee's decision be left open so that the opinion of the courts might be taken.

The Referee said it seemed futile for Sir Arthur to ask him to state a case at that moment. He was not *functus officio*. After a little discussion, the Referee said he would give Sir Arthur an opportunity to ask him to state a case on the point he had raised.

This concluded the inquiry.

Canadian Marking Act

THE High Commissioner for Canada has received a cablegram from the Department of Customs, Ottawa, announcing that the enforcement of the provisions for the Marking of Imported Goods Act has been postponed by Order in Council until the close of the next session of Parliament.

From Week to Week

SIR WILLIAM POPE has just returned to this country from his tour of India.

DR. L. SIMON, of Capetown University, has been appointed Reader in Physics to the London University.

A lecture on "THE USES OF PHOSPHATES" was delivered at Darlington last week by Dr. J. A. Hawley, of Leeds University.

The Supply Officer, Australia House, Strand, London, invites TENDERS FOR LABORATORY GLASSWARE. Tenders should be submitted by January 30.

It is reported from Washington that the Chino-Japanese representatives have reached an agreement for the return to China of the SHANTUNG SALT MINES.

MR. W. F. REID will represent the Society of Chemical Industry on the general committee of the British Empire Exhibition, 1923, pending the acceptance of Dr. Ruttan.

Many inquiries under the SAFEGUARDING OF INDUSTRIES ACT were foreshadowed on Tuesday at a meeting of the Fancy Goods Section of the London Chamber of Commerce.

Tenders are invited by February 2 for the supply of 175,000 gallons of LIGHT MINERAL OIL. Particulars may be obtained from Mr. M. K. Smith, Trinity House, Tower Hill, London, E.C. 3.

The following appointments in the University of Manchester are announced: MR. W. S. VERNON, Assistant-Lecturer in Physics; MRS. M. B. CRAVEN, M.Sc., Assistant-Lecturer in Chemistry.

At a meeting of the Swansea Rotary Club on Monday MR. A. M. O'BRIEN, manager of the Anglo Persian Oil Co.'s refineries at Swansea, gave an address on "Petroleum Products."

On February 8, at 8 p.m., Professor W. Rothenstein, Principal of the Royal College of Art will distribute the prizes gained by the students of the SIR JOHN CASS TECHNICAL INSTITUTE during the past session.

DR. D. J. HARRIES presented his resignation as lecturer in physiological chemistry and assistant lecturer and demonstrator in physiology to a special meeting of the Cardiff University College Council on Friday.

The general committee of subscribers to the RAYLEIGH MEMORIAL FUND have offered to the University of Cambridge the sum of £687, being the balance of the fund, for the purpose of the library of the Cavendish Laboratory.

HEMINGWAY'S CHEMICAL PROCESSES CO., LTD., of Marsh Gate Lane, Stratford, London, E. 15, announce that with the sanction of the Board of Trade the name of the company has been changed to "Hemingway & Co., Ltd."

Among the Japanese business men at present in England with the Japanese Industrial Mission is MR. KATSUTARO INAHATA, importer and exporter of chemicals and dyes, and president of the Osaka Chamber of Commerce.

MR. A. R. DAWSON, who has been appointed organising secretary to the Appeal Committee of the Physics and Chemistry Sections of the South Wales University College, was the guest of the Newport Rotary Club at a luncheon last week.

Messrs. J. L. Baker and F. H. Carr have been appointed by the council of the Society of Chemical Industry to serve upon a standing committee on the STANDARDISATION OF SCIENTIFIC GLASSWARE to be set up by the National Physical Laboratory.

A bureau of information upon American chemical plant specialities has been opened at 121, St. Stephen's House, Westminster, London, S.W. 1, by MESSRS. NEWITT & SON, who are prepared to supply applicants with catalogues, information, specifications and estimates.

At a meeting of the Senate of the London University on Wednesday the degree of D. Sc. IN CHEMISTRY was conferred on Messrs. E. B. Maxted and S. C. Bradford. Dr. M. O. Forster was appointed a delegate at the Congress of Universities of the British Empire to be held in London in May.

The death occurred on January 20, in a Liverpool nursing home, of MR. ISAAC CARR, engineer and manager of the Widnes Corporation gas and water departments, at the age of sixty-four years. Mr. Carr, who was a member of the Institution of Gas Engineers, had been for many years a well-known and much-respected figure in the gas industry.

The Director of the Public Works Department, Bagdad, Iraq, is ANXIOUS TO OBTAIN CATALOGUES, designs, specifications, prices, &c., relating to well-boring plant, cement and

concrete mixers, portable lime kilns using crude oil fuel, power plant, petrol and oil tanks with measuring gauges, aerial ropeways and refrigerating apparatus.

The committee under Part. II. of the Safeguarding of Industries Act, which has inquired into the application to impose an IMPORT DUTY ON GOLD LEAF imported from Germany, completed its hearing of the evidence on January 24. After evidence had been heard the chairman announced that the committee would report to the Board of Trade in due course.

A practical effort has now been started by the Pure Plantation Rubber Products, Ltd., to bring before the buying public the possibilities of PURE RUBBER ARTICLES. The promoters are endeavouring to supply only those goods that contain a standard of 100 per cent. pure plantation rubber, or, where this is not attainable, with as high a percentage as is possible.

THE FUEL RESEARCH BOARD have made arrangements for the recognition of the Lancashire and Cheshire Coal Research Association as the local committee working under the Board for the purpose of dealing with the physical and chemical survey of the coal seams in this area. The chairman of the committee is Mr. Robert Burrows, and the director of research Mr. F. S. Sinnatt.

The Federation of British Industries has arranged to meet the Committee of General Managers of Railways on February 7, with a view to obtaining some reduction in railway rates for general merchandise. The agenda for the first day will deal with the industries under Group 9 of the F.B.I. scheme, and proposals will be made for CHEAPER RATES for chemical fertilisers and explosives.

A paper on "PYROMETRY" was read by Mr. R. L. Granville Johnston, on Tuesday, at a meeting in Newcastle-on-Tyne of the North-Eastern Section of the Junior Institution of Engineers. The author briefly reviewed the history of pyrometry, gave a short description of the Wedgwood clay pyrometer, and concluded with a description of the modern thermo-electric instruments.

The Council of the University of Birmingham announce that in order permanently to associate the name of Professor Percy Frankland, F.R.S., D.Sc., with the Chemical Department of the University, and to commemorate his work in chemical science, a fund has been subscribed to provide a FRANKLAND MEDAL AND PRIZE OF BOOKS, to be awarded annually to the best student of practical chemistry.

Employees of Brunner, Mond, & Co., Ltd., were, on Monday, presented with gold and silver watches, the former being given for thirty-five years' and the latter for twenty-five years' CONTINUOUS SERVICE WITH THE FIRM. The total number of watches presented to date to employees at Winnington, Lostock, Middlewich, Sandbach, and Silvertown is 1,628. Mr. Roscoe Brunner, in making the presentations, said there was not a concern in the world which could equal their record of 1,628 men with over twenty-five years' service.

Papers on "The Action of Light on Silver Bromide," by E. J. Hartung; "The Structure of the Benzene Nucleus. Part I. Intra-nuclear Tautomerism," by C. K. Ingold; "The Structure of the Benzene Nucleus. Part II. Synthetic Formation of the Bridged Modification of the Nucleus," by C. K. Ingold; and "The Structure of the Benzene Nucleus. Part III. The Suppression of Intra-nuclear Changes," by C. K. Ingold and H. A. Piggott, will be read at a meeting of the CHEMICAL SOCIETY at Burlington House, London, on February 2.

At an INFORMAL MEETING of the Edinburgh and East of Scotland Section of the Society of Chemical Industry held in Edinburgh on January 18, Dr. H. E. Watt presiding, Mr. C. J. Abernethy demonstrated the Shakespear Katharometer, and Mr. W. G. Martin the Pusey James Plastometer. Mr. A. H. Baird exhibited a reflex lantern, micro lantern, a new form of Bunsen burner, universal boss-head clamp, and other pieces of apparatus. There was also an exhibit from Baird & Tatlock, Ltd., consisting of a new analytical balance and some oil-testing apparatus.

Lecturing at University College, London, on January 21, on "Yeast: What it is and what it does," Mr. A. CHESTON CHAPMAN said that the diameter of a yeast cell was only one three-thousandth part of an inch, and in 1 oz. of yeast there were 50,000 cells. The fact that the yeast cell, one of Nature's simplest structures, could be capable of so many chemical processes was one of the unexplained wonders of the world, and when scientists were capable of working as quietly and efficiently in their laboratories as the yeast cell they would begin to deserve the title of "chemist."

References to Current Literature

British

- HYDROLYSIS.** The influence of neutral salts on the hydrolysis of ethyl formate. A. B. Manning. *Chem. Soc. Trans.*, December, 1921, pp. 2079-2087.
- ADSORPTION.** The adsorption of thorium-B and thorium-C by ferric hydroxide. J. A. Cranston and R. A. Burnett. *Chem. Soc. Trans.*, December, 1921, pp. 2036-2044.
- SOLUBILITIES.** The solubility of glucinum sulphate in water and sulphuric acid at 25°. H. T. S. Britton. *Chem. Soc. Trans.*, December, 1921, pp. 1967-1971.
- DISTILLATION.** The separation of miscible liquids by distillation. A. F. Dufton. *Chem. Soc. Trans.*, December, 1921, pp. 1988-1994.
- HETEROCYCLIC COMPOUNDS.** The nitro- and amino-derivatives of 4-phenyl-glyoxaline. R. L. Grant and F. L. Pyman. *Chem. Soc. Trans.*, December, 1921, pp. 1893-1903.
- Synthesis in the thianthren series. Part I. J. N. Ray. *Chem. Soc. Trans.*, December, 1921, pp. 1959-1967.
- ELECTRO-CHEMISTRY.** Symposium on electrodeposition and electroplating. Electroplating for the prevention of corrosion; some applications of electrodeposition in aeronautical engineering; the electrodeposition of cobalt; the commercial electrolysis of zinc sulphate solutions; the deposition of gold-silver alloys; the use of colloids in the electrodeposition of metals; electro silver plating—its technical development; the chemical composition of old silver plating solutions; a new maximum current density in commercial silver plating; the crystalline structure of electrodeposited silver. *Trans. Faraday Soc.*, July, 1921, pp. 471-553.
- COLLOIDS.** Symposium on the physics and chemistry of colloids and their bearing on industrial questions. Introduction; emulsions and emulsification; the physical properties of elastic gels; glass and pyrosols; non-aqueous colloidal systems; precipitation of disperse systems; electric endosmosis and cataphoresis; the proteins and colloid chemistry; the internal pressure of liquids. Appendix to *Trans. Faraday Soc.*, July, 1921, pp. 1-190.
- DYEING.** Dyeing wool in cold baths. C. Douche. *Dyer*, January 1, 1922, pp. 6-7.

United States

- ORGANIC ARSENIC COMPOUNDS.** The relation between the mode of synthesis and toxicity of arspenamine and related compounds. W. G. Christiansen. *J. Amer. Chem. Soc.*, October, 1921, pp. 2202-2210.
- 7-Chloro-7,12-dihydro- α -benzophenarsazine and some of its derivatives. W. L. Lewis and C. S. Hamilton. *J. Amer. Chem. Soc.*, October, 1921, pp. 2218-2223.
- 2-Phenylquinoline-4-carboxy-6-arsonic acid. J. R. Johnson and R. Adams. *J. Amer. Chem. Soc.*, October, 1921, pp. 2255-2257.
- GERMANIUM.** Germanium. Part I. Extraction from germanium-bearing zinc oxide; non-occurrence in samarskite. L. M. Dennis and J. Papish. *J. Amer. Chem. Soc.*, October, 1921, pp. 2131-2143.
- ETHERS.** B,8'-Dichloro-diethyl ether: the oxygen analogue of mustard gas. O. Kamm and J. H. Waldo. *J. Amer. Chem. Soc.*, October, 1921, pp. 2223-2227.
- γ,γ' -Dihalogeno-dipropyl ethers. O. Kamm and W. H. Newcomb. *J. Amer. Chem. Soc.*, October, 1921, pp. 2228-2230.
- REDUCTION.** The reduction of copper oxide by hydrogen. R. N. Pease and H. S. Taylor. *J. Amer. Chem. Soc.*, October, 1921, pp. 2179-2188.
- ANTIMONY SULPHIDES.** Polymorphic transformations of antimony trisulphide. S. Wilson and C. R. McCrosky. *J. Amer. Chem. Soc.*, October, 1921, pp. 2178-2179.
- CHLORINATION.** Chlorination and the formation of chloroamines by means of nitrogen trichloride. G. H. Coleman and W. A. Noyes. *J. Amer. Chem. Soc.*, October, 1921, pp. 2211-2217.
- GUANIDINE.** Preparation of guanidine nitrate. T. L. Davis. *J. Amer. Chem. Soc.*, October, 1921, pp. 2234-2238.
- The action of ammonia water on dicyandiamide. T. L. Davis. *J. Amer. Chem. Soc.*, October, 1921, pp. 2230-2233.

- ORGANIC MERCURY COMPOUNDS.** An indirect method of preparation of organic mercuric derivatives and a method of linking carbon to carbon. M. S. Kharasch. *J. Amer. Chem. Soc.*, October, 1921, pp. 2238-2243.
- COLLOIDS.** Coagulation of colloidal solutions of arsenious sulphide by electrolytes. E. F. Burton and E. D. MacInnes. *J. Phys. Chem.*, October, 1921, pp. 517-525.
- The size-frequency distribution of particles of silver halide in photographic emulsions and its relation to sensitometric characteristics. Part II. The methods of determining size-frequency distribution. E. P. Wightman and S. E. Sheppard. *J. Phys. Chem.*, October, 1921, pp. 561-594.
- LEAD COMPOUNDS.** Reactions in fused salt media. Part I. A study of the basic lead chromates. J. F. G. Hicks. *J. Phys. Chem.*, October, 1921, pp. 545-560.
- DYESTUFFS.** Notes on the manufacture of methylene blues. Part I. R. Sansone. *Color Td. J.*, December, 1921, pp. 237-240.
- Colours and dyes from para-phenetidine. J. G. Schmidt. *Color Td. J.*, December, 1921, pp. 243-244.
- Properties and application of fustic. Part II. J. F. Springer. *Color Td. J.*, December, 1921, pp. 250-251.

French

- HYDROCARBONS.** Relation between the molecular properties of certain hydrocarbons and their capacity for fixing iodine. *Compt. rend.*, December 27, 1921, pp. 1471-1473.
- ZIRCONIUM.** Zirconium and zirconia. L. Andrieux. Bibliography. *L'Ind. Chim.*, December, 1921, pp. 478-481.
- INKS.** Writing inks and their manufacture. M. de Keghel. *Rev. Chim. Ind.*, December, 1921, pp. 357-367.
- HYDROGENATION.** Hydrogenation of some oils of marine animals. H. Marcelet. *Chim. et Ind.*, December, 1921, pp. 765-768.
- PERFUMES.** Artificial musk. E. Noelting. Bibliography. *Chim. et Ind.*, December, 1921, pp. 719-736.
- FILTRATION.** Centrifugal decantation. R. Berline. *Chim. et Ind.*, December, 1921, pp. 737-745.
- ANALYSIS.** Review of analytical chemistry. A. Kling and A. Lassieur. *Chim. et Ind.*, December, 1921, pp. 746-764.

German

- PEPPERS.** Natural and artificial peppers and the relation between chemical constitution and pepper taste. E. Ott and K. Zimmermann. *Annalen*, December 8, 1921, pp. 314-337.
- ACIDS.** Polythionic acids and polythionates. E. H. Riesenfeld and G. W. Feld. *Z. anorg. u. allg. Chem.*, November 15, 1921, pp. 225-270.
- Aqueous solutions of carbonic acid. E. Wilke. *Z. anorg. u. allg. Chem.*, November 15, 1921, pp. 365-379.
- OXIDATION.** Oxidizing action of carbon suspensions. F. Feigl. *Z. anorg. u. allg. Chem.*, November 15, 1921, pp. 305-309.
- HOMOLOGOUS COMPOUNDS.** The oscillation of the physical constants in homologous series. H. Pauly. *Z. anorg. u. allg. Chem.*, November 15, 1921, pp. 271-291.
- CRYSTALLISATION.** The velocity of crystallisation under high pressure. M. Hasselblatt. *Z. anorg. u. allg. Chem.*, November 15, 1921, pp. 325-352.
- ANALYSIS.** Qualitative determination of pyrophosphoric acid in presence of ortho- and meta-acids. D. Balarew. *Z. anal. Chem.*, Nov. 11, 1921, pp. 385-392.
- ANALYSIS.** Determination of aluminium. E. J. Kraus. *Chem.-Zeit.*, December 6, 1921, p. 1173.
- Improved method for the separation of iron and manganese. M. Carus. *Chem.-Zeit.*, December 10, 1921, p. 1194.
- Rapid estimation of mercury in ores. Part II. A. Heinzelmänn. *Chem.-Zeit.*, December 20, 1921, pp. 1226-1227.
- CELLULOSE ESTERS.** Preparation of cellulose esters; cellulose stearate and laurate. A. Grün and F. Wittka. *Z. angew. Chem.*, December 27, 1921, pp. 645-648.
- HYDROCHLORIC ACID.** The combination of chlorine and hydrogen without explosion to hydrochloric acid by the aid of contact substances. B. Neumann. *Z. angew. Chem.*, December 15, 1921, pp. 613-620.

Patent Literature

Abstracts of Complete Specifications

172,739. COKE OVENS. B. Zwilling, 520, West 188th Street, New York. Application date, September 15, 1920.

The coke oven is of the kind in which a horizontal coking chamber is externally heated by flues beneath. In one form a number of combustion flues extending beneath the full length of the oven are each supplied with fresh gas and air alternately at opposite ends of the oven. A recuperator is arranged transversely below the oven at each end, and comprises a horizontal waste gas flue with an adjacent air inlet flue immediately below and an adjacent flue immediately above which distributes the hot air to the combustion chambers. Openings are provided along the top of the oven for the supply of coal. In a modification, the combustion flues 29, 30, are divided by a central vertical wall 300 into two equal parts, and the flues are divided longitudinally by walls 31. The upper wall of the flues forms the floor of the

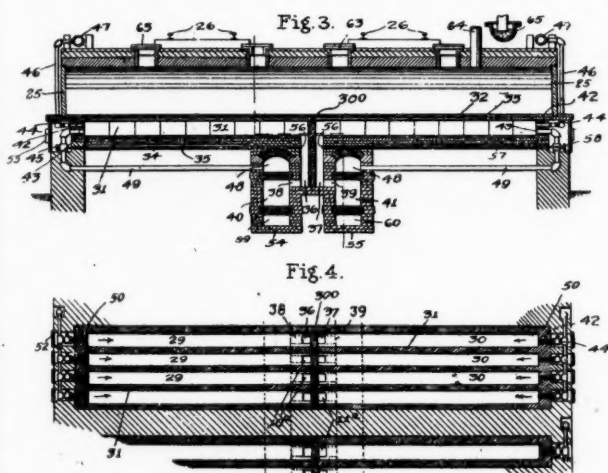
is found that about 75 per cent. of the butyl alcohol is converted into butyric aldehyde in one passage through the apparatus. The liquid butyric aldehyde is mixed with a small proportion of an oxygen-carrying catalyst such as manganese butyrate, and air or oxygen is passed through the mixture at atmospheric or at a higher pressure. The temperature is kept below the boiling point of the mixture by means of water cooling, and the aldehyde is converted into butyric acid. The gas may be passed through a water condenser and finally scrubbed with normal butyl alcohol to extract any butyric aldehyde.

173,006. DYESTUFF INTERMEDIATES, PRODUCTION OF. J. Thomas, A. H. Davies and Scottish Dyes, Ltd., Murrell Hill Works, Carlisle. Application date, July 23, 1920.

The process is for producing amido-anthraquinones. 1-chlor-anthraquinone is heated with ammonia of 26 per cent. strength to 170°C. for twelve hours in an autoclave and 1-amido-anthraquinone is produced in almost theoretical quantity and of good quality. If 0.1 per cent. of copper sulphate is added to the reaction mixture the yield may be improved. By similarly heating the dichlor-anthraquinones with ammonia in an autoclave the corresponding diamido compound can be obtained.

173,060. SULPHURIC ACID, PROCESSES OF MAKING. C. J. Reed, 307, West Glenside Avenue, Glenside, Pa., U.S.A. Application date, September 20, 1920.

In the lead chamber process for making sulphuric acid, a reaction takes place between sulphur dioxide, air, higher



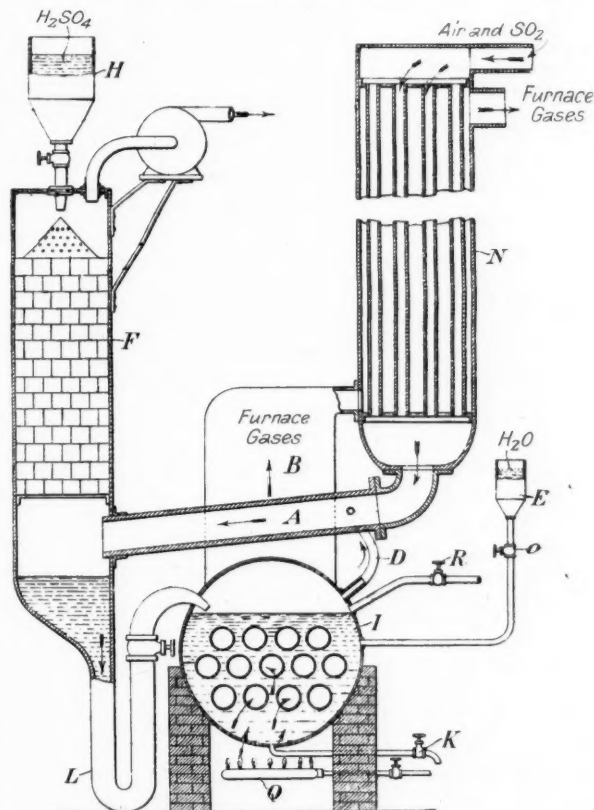
172,739

oven. Each combustion flue 29, 30 is provided with a separate vertical waste gas channel 36, 37 connected by short passages 38, 39 to the waste gas flues 40, 41 of the recuperators, which are placed below the centre of the oven. The air supply is heated in the flues 59, 48, and supplied by the pipe 49 to the nozzles 43 adjacent to the gas nozzles 42. In another modification, the preheated air from the recuperators is still further heated by passing it from the upper flue 48 through other flues arranged parallel to the combustion flues and immediately below them. Additional heating flues may also be provided in the walls between the coking chambers. In another modification, the transfer of heat in the recuperator from the waste gases to the air is made more efficient by arranging the air flues so that they are practically surrounded by the waste gas flues. The invention may be applied to existing rectangular ovens so as to convert these into ovens with by-product recovery, without any modification of the side walls or roof, or of the general arrangement of the ovens.

173,004. BUTYRIC ALDEHYDE AND BUTYRIC ACID, PRODUCTION OF. M. A. Adam, 57, Lincoln's Inn Fields, London, W.C. 2, and D. A. Legg, 10A, Featherstone Buildings, W.C. 1. Application date, July 20, 1920.

Normal primary butyl alcohol is converted into butyric aldehyde by dehydrogenation by means of a catalyst such as fused cupric oxide prepared as described in Specification No. 166,249 (see THE CHEMICAL AGE, Vol. IV., p. 214). The butyric aldehyde may subsequently be oxidised by means of air or oxygen to butyric acid. In an example, normal primary butyl alcohol is vaporised and passed over fused cupric oxide or a copper catalyst obtained from it. The temperature is preferably maintained between 280° and 320°C., and the vapour passes to a condenser. The condensate of butyric aldehyde and butyl alcohol is separated by distillation. It

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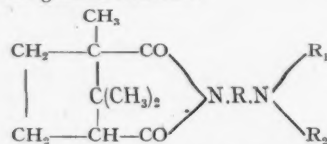
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oxides of nitrogen, and steam, with the production of dilute sulphuric acid and nitric oxide. The dilute sulphuric acid is subsequently evaporated to obtain concentrated sulphuric acid. In the present invention steam is not added and the subsequent evaporation of the dilute acid is thus avoided. The formation of solid compounds of sulphur trioxide with oxides of nitrogen which would normally occur in the absence

of steam is also avoided. The reaction between sulphur dioxide, excess of air, and higher oxides of nitrogen, takes place in a reaction chamber, which is maintained at a temperature sufficiently high to ensure that the compounds of sulphur trioxide and oxides of nitrogen remain in a gaseous state. The gaseous mixture is then passed through concentrated sulphuric acid, which absorbs all but the residual oxygen and nitrogen. The mixture, while still hot, is then treated with the exact amount of water necessary to liberate the oxides of nitrogen, which may be used again, and to produce concentrated sulphuric acid. The reaction chamber A is constructed of a material such as burned clay, which resists nitric and sulphuric acids, and oxides of nitrogen and sulphur. This chamber is maintained at 200°-400°C. by furnace gases B. The inflowing mixture of air and sulphur dioxide passes through a counter-current heater N, heated by waste furnace gases, and the oxides of nitrogen are added through the pipe D. The reaction products pass to a condenser F consisting of a vertical cylindrical acid tower containing broken material, to which concentrated sulphuric acid is supplied from the reservoir H. The acid with the absorbed gases passes through a liquid seal L to an evaporator I, to which water is supplied from the reservoir E. The oxides of nitrogen are liberated and delivered through the pipe D for use again, while the concentrated acid may be drawn off through the valve K. Air may be introduced through the valve R. The evaporator I is maintained at a temperature slightly below the boiling point of concentrated sulphuric acid, and is heated by the same source Q, which heats the reaction chamber A.

173,063. CAMPHORIC ACID, MANUFACTURE OF SOLUBLE DERIVATIVES OF. O. Imray, London. (From the Society of Chemical Industry in Basle, Switzerland.) Application date, September 21, 1920.

The process is for obtaining soluble derivatives of camphoric acid having the general formula:



in which R=alkyl or alkylene; and R₁ and R₂=hydrogen, alkyl, or alkylene. These are obtained from camphoric acid, its anhydride or imide, by ordinary methods analogous to those used for the manufacture of corresponding derivatives of other dicarboxylic acids. Camphoric acid imide as a dry salt or an alkaline solution is treated with poly-halogenised saturated or unsaturated aliphatic hydrocarbons or halogen hydrides. The N-halogen-alkyl or N-halogen-alkylene camphoric acid imide is then treated with ammonia or an alkylamine or alkylene-amine. Alternatively, camphoric acid or its anhydride may be treated with a diamine having the formula H₂N.R.NR₁R₂, where R, R₁, R₂ have the meanings indicated above. Detailed examples are given of the preparation of β-amino-ethyl camphoric acid imide hydrobromide, β-dimethyl-amino-ethyl camphoric acid imide hydrobromide, β-diethyl-amino-ethyl camphoric acid imide hydrobromide, β-allylamino-ethyl camphoric acid imide hydrobromide, β-diethyl-amino-ethyl camphoric acid imide hydrochloride, and β-piperidyl-ethyl-camphoric acid imide hydrobromide. These compounds have all the valuable therapeutic properties of camphor, and, in addition, are easily soluble in water and alcohol and are stable when heated.

173,097. ALCOHOLS, KETONES AND THE LIKE, MANUFACTURE AND PRODUCTION OF. J. Y. Johnson, London. (From Badische Anilin & Soda Fabrik, Ludwigshafen-on-Rhine, Germany.) Application date, October 9, 1920.

When potassium or sodium formate is decomposed by heat the oxide or carbonate is produced and hydrogen is given off. Formates of other metals treated in this manner give off valuable organic products such as methyl alcohol, acetone, formaldehyde, and oily substances. The latter reaction has not previously been suitable for the commercial manufacture of alcohols, ketones and aldehydes, since the formates could only be obtained by the use of free formic acid, the cost of which would be prohibitive. Formates of potassium and sodium, though readily obtained by treating the hydroxides with carbon monoxide, do not yield the required organic products. It has now been found that lithium formate possesses the desired properties. It may be obtained by treating the hydroxide or carbonate with carbon monoxide,

and yields methyl alcohol and acetone on heating. The process may be carried out in a closed cycle so that the same quantity of lithium is repeatedly used. In an example, a solution of 1 part of lithium hydroxide in 2 parts of water is treated with carbon monoxide at 160°-170°C., and a pressure of 20-30 atmospheres. The lithium formate is evaporated to dryness, and is then heated to 350°-400°C., rising gradually to 420°C. The vapour is passed through a condenser and the condensate is purified by fractional distillation. The residue of lithium carbonate and carbon is mixed with water and boiled with the requisite amount of calcium oxide to convert it into lithium hydroxide which is filtered off and used again in the process. The formate is preferably decomposed in thin layers in shallow pans or revolving drums at a reduced pressure. It is found that lithium carbonate may be converted directly into the formate by the action of carbon monoxide at 120°-250°C., and at a pressure of 70 atmospheres. The carbon dioxide is continuously removed from the gas by washing with water under pressure. In this process the temperature of decomposition of the formate must be accurately regulated, and is preferably between 380° and 405°C. Carbon monoxide may be used in the form of producer gas or water gas, and the gases remaining after the condensation of the alcohols, ketones, and aldehydes may also be used for this purpose.

173,099. CARBONISATION AND DISTILLATION OF CARBONACEOUS MATERIAL. J. A. Chown, 50, Pall Mall, London, S.W. 1. Application date, October 9, 1920.

The apparatus is for distilling carbonaceous material such as cannel coal, or torbanite. The material is ground and charged into a distillation chamber with liquid hydrocarbon and the mixture is distilled at a low temperature with continuous stirring. The volatile products are drawn off and condensed. The mixture is then passed through a valve in the bottom of the chamber into a retort below, in which it is heated to carbonising temperature and the less volatile compounds drawn off. The carbonised residue is discharged from the retort through a valve provided with scrapers in the retort for breaking up the material. The material may then be subjected to any desired further treatment, such as briquetting.

173,166. 1-CHLORO-2-AMINO ANTHRAQUINONE, MANUFACTURE OF. A. W. Fyfe, of Dalton Works, Huddersfield, and British Dyestuffs Corporation, Ltd., Imperial House, Kingsway, London, W.C. 2. Application date, December 21, 1920.

2-amino anthraquinone is usually acetylated before chlorination in order to protect the amino group. It is now found that 2-amino anthraquinone can be directly chlorinated in the presence of solvents such as acetic acid, nitro-benzene, chloro-benzene, &c., yielding 1-chloro-2-amino anthraquinone. In an example, the finely-powdered 2-amino anthraquinone is suspended in ten times its weight of nitrobenzene and treated with chlorine at 15°C. The hydrochloride of the 1-chloro derivative is filtered off and treated with water to obtain 1-chloro-2-amino anthraquinone. A yield of 88 per cent. may be obtained.

NOTE.—Abstracts of the following specifications which are now accepted appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention: 148,126 (Chemische Fabriken Worms Akt.-Ges.) relating to tanning agents, see Vol. III., p. 455; 149,347 (Deutsche Erdöl Akt.-Ges.) relating to process for separating solid and liquid hydrocarbons, see Vol. III., p. 543; 153,006 (Ges. für Landwirtschaftlichen Bedarf and R. Mandelbaum) relating to extracting a fertiliser from gas liquor, see Vol. IV., p. 105; 161,977 (M. J. Davidsen) relating to grinding or crushing apparatus, see Vol. IV., p. 703; 164,715 (Soc. Chimique des Usines du Rhone, Anciennement Gilliard, P. Monnet et Cartier) relating to oxaldehydes and their derivatives, see Vol. V., p. 192.

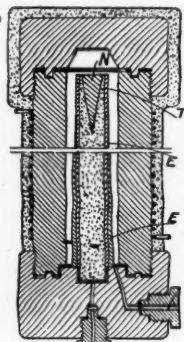
International Specifications not yet Accepted

171,956. SYNTHETIC RESINS AND TANNING AGENTS. Elektro Chemische Werke Ges., 35, Dorotheenstrasse, Berlin, and H. Bosshard and D. Strauss, Bitterfeld, Germany. International Convention date, July 4, 1919.

Naphthalene is heated in an autoclave to 130°-170°C. with glycolic acid or glycolide, and an acid substance such as phosphorus pentoxide to produce a resinous condensation product resembling shellac. The product may be sulphonated to yield a tanning agent.

171,970-2. AMMONIA SYNTHESIS. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés. G. Claude, 48, Rue St. Lazare, Paris. International Convention date, November 20, 1920.

171,970. The apparatus is for the synthesis of ammonia under very high pressures by the process described in specification 161,195 (see THE CHEMICAL AGE, Vol. IV., p. 654), and the object is to heat the incoming gas by the heat evolved in reaction. The inlet end of the reaction tube T is not surrounded by heat-insulating material so that the gas passing over the outer surface is heated. The insulation E over the remainder of the tube increases in thickness gradually towards its outlet end so that the incoming gas is gradually heated. The catalyst is modified so that its activity increases towards the outlet end, if the temperature at the inlet and tends to become too high, or alternatively the temperature may be controlled by inserting a conical core N of inert material at the inlet end.



171,970.

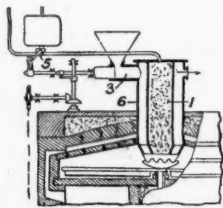
171,976. CATALYTIC MATERIALS FOR AMMONIA SYNTHESIS. Norsk Hydro-Elektrisk Kvaestofaktieselskab, 7, Soltigaten, Christiania. International Convention date, November 22, 1920.

A pyrophoric catalyst such as iron or other heavy metal is protected from the action of air by treating it with water-vapour or carbon dioxide while still in the reaction chamber.

172,006 and 172,010. FURNACES. R. Moritz, 2, Avenue de Pommeren, Chatou, Seine-et-Oise, France. International Convention date, November 23, 1920.

172,006. The rabble teeth in a sulphate furnace are made of ferro-silicon containing 12-16 per cent. of silicon.

172,010. The furnace is for the manufacture of sodium or potassium sulphate. The acid is supplied through a valve 5 to an inner tube 1 packed with inert material which is heat-conducting, and the salt is supplied by a pusher 3 to an outer tube 6. Both materials are discharged on to a vessel of cast-iron or ferro-silicon carried by the rabble shaft, and mixing is effected by blades projecting from the tubes 1, 6. The hot hydrochloric acid gas escapes through the tube 6 so as to preheat the salt and the acid. The rabble shaft, pusher 3, and valve 5 are all interconnected and actuated by the same driving gear.



172,010

172,009. SULPHURIC ACID TOWERS. R. Moritz, 2, Avenue de Pommeren, Chatou, Seine-et-Oise, France. International Convention date, November 23, 1920.

The towers are of rectangular cross-section and are divided by horizontal partitions of ceramic material having small perforations which allow liquid to pass but practically no gas. The compartments are packed with acid-proof filling, and the partitions project from each wall alternately so that the gases pass horizontally through the compartments in series. Lead pipe coils are provided adjacent to each partition and water is circulated through them to render the intensity of the reaction uniform throughout the series of towers. The water passes from the tubes in the hottest towers to those in the coolest towers.

172,012. FATS AND SOAPS, RECOVERING FROM WASH LIQUORS. J. Duclaux, 34, Rue du Bac, Paris. International Convention date, November 23, 1920.

Water from wool-washing plant is filtered under pressure through a membrane of collodion, denitrated collodion, or cellulose precipitated from a cupro-ammoniacal solution. The fatty acids and their alkaline earth salts and insoluble organic material are retained, while the filtrate containing

mineral salts and alkaline salts of lower fatty acids may be used again for washing purposes. The filtered residue is removed by reversing the pressure, and the filter is cleaned with dilute acids, alcohol, acetone, methyl alcohol or methyl acetate. The soapy water may be similarly treated before use to extract fatty acids.

172,027. SODIUM CYANIDE. H. Mehner, 66, Schlosstrasse, Charlottenburg, Berlin. International Convention date, November 26, 1920.

A mixture of sodium carbonate and a large excess of carbon is heated on a furnace hearth consisting of hollow iron plates placed on edge and cooled by means of water or cold gases. Nitrogen is introduced, and the sodium cyanide formed is drawn off through the hearth, thus avoiding decomposition by contact with other products. Water may be injected into the reaction products to produce ammonia and soda.

LATEST NOTIFICATIONS

174,027. Process for decolourising liquids. Straatman, J. F. January 13, 1921.

174,032. Process for preparing derivatives of borigle in view of preparing synthetic camphor. Peuffaillit, L. January 10, 1921.

174,038. Vulcanising apparatus and process. Fetter, E. January 10, 1921.

174,040. Process and apparatus for the production of carbon disulphide from its elements. Chemische Fabrik Greisheim-Elektron. January 14, 1921.

174,041. Apparatus for the synthesis of ammonia. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés. G. Claude. January 14, 1921.

174,046. Apparatus for electrically precipitating suspended particles from fluids. Siemens-Schuckertwerke Ges. January 14, 1921.

174,052. Continuous process for the manufacture of barium hydrate. Deguide, C. January 8, 1921.

174,077. Process for the production of low-temperature tar, semi-coke, and gas from solid carbonaceous materials. Weiss, J. January 13, 1921.

174,078. Process of preparing arseno-compounds. Farbwerken vorm. Meister, Lucius & Bruning. January 13, 1921.

174,084-8. Process and apparatus for cracking hydrocarbon oils. Gulf Refining Co. January 15, 1921.

174,089. Pyrogenetic treatment of hydrocarbon oils. January 15, 1921.

Specifications Accepted, with Date of Application

146,159. Phenolic condensation products, Manufacture of, Redmanol Chemical Products Co. June 6, 1918.

146,182. Tanning-agents, Manufacture of. Gerb-und Farbstoffwerke H. Renner & Co. November 21, 1918. Addition to 146,167.

146,351. Iron ores containing phosphates, Process for opening-up. Dr. R. Eberhard. February 23, 1918.

147,189. Gaseous mixtures, Means for separating the constituent elements of. E. N. Mazza. September 7, 1915.

156,592. Evaporating liquids, apparatus for. K. L. E. Thunholm. March 4, 1918.

167,185. Gas, Purification of. N. Klärting. July 28, 1920.

173,538. Reactive acid liquor, alcohols, esters and the like from gaseous hydrocarbons, Process for the production of. S. B. Hunt. June 30, 1920.

173,539. Secondary alcohols into ketones, Process and apparatus for the conversion of. S. B. Hunt. June 30, 1920.

173,540. Phenyl glycine compounds, Manufacture of. British Dyestuffs Corporation, Ltd. H. Levinstein, and G. Imbert. July 2, 1920.

173,545-6. Vulcanising rubber, Process of—and manufacture of an accelerator for use therein. H. Wade. (Goodyear Tire & Rubber Co.) July 6, 1920.

173,567. Lithopone, Manufacture of. J. L. Mitchell. September 1, 1920.

173,603. Crucible-type furnaces. Selas Turner Co., Ltd., and E. Turner. October 4, 1920.

173,624. Decolourising carbon, Manufacture of. J. N. A. Sauer. October 9, 1920.

173,644. Dehydrating hydrocarbon emulsions and/or distilling hydrocarbon oils or their products of distillation. Asiatic Petroleum Co., Ltd., and W. Cameron. October 21, 1920.

173,662. Distillation of peat, Apparatus for—and recovery of products. A. J. Robus. November 8, 1920.

173,692. Ozone-generating apparatus. R. Goedicke. December 18, 1920.

173,709. Heat treatment of liquid. W. Mauss. March 8, 1921.

173,723-4. Volatile bodies, Apparatus for effecting the fractional condensation of mixtures of the vapours of. Selden Co. J. M. Selden, and C. G. Selden. July 5, 1920.

173,725. Centrifugal apparatus for separating solid particles from air, Rotary valves for use with. T. Robinson & Son., Ltd. and C. J. Robinson. September 2, 1920.

Market Report and Current Prices

Our Market Report and Current Prices are exclusive to THE CHEMICAL AGE, and, being independently prepared with absolute impartiality by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., may be accepted as authoritative. The prices given apply to fair quantities delivered ex wharf or works, except where otherwise stated. The weekly report contains only commodities whose values are at the time of particular interest or of a fluctuating nature. A more complete report and list are published once a month. The current prices are given mainly as a guide to works managers, chemists, and chemical engineers; those interested in close variations in prices should study the market report.

LONDON, JANUARY 26, 1922.

THERE has been some improvement in the uptake of chemicals during the past week, although buyers generally limit their orders to such quantities as are required for immediate consumption. Prices on the whole are fully maintained, and such movement as occurs is chiefly in an upward direction. All things said, the tone and volume of trade is very disappointing, and prospects of a substantial improvement remain very uncertain.

The volume of export inquiry is fair, but comparatively little actual business is reported.

General Chemicals

ACETONE is firm in price, and stocks are rapidly absorbed. ACID ACETIC is in short supply for early delivery, and the price has advanced strongly. ACID CITRIC.—Unchanged; remains a very uninteresting market. ACID FORMIC.—Stocks appear to have been exhausted, and consumers are now feeling the effects of the import duty. Higher prices are expected. ACID LACTIC.—In this case, also, stocks imported free of duty are coming to an end, and, as was expected, the price is steadily advancing. ACID OXALIC is firmer, although the demand remains small. ACID TARTARIC.—English makers report a certain amount of business, and the price is unchanged. BLEACHING POWDER.—Little or nothing is offered from the Continent, but the tendency remains easy. CALCIUM CARBIDE.—Unchanged. COPPER SULPHATE.—Although there has been decidedly more inquiry, little or no business can be detected. FORMALDEHYDE is likely to advance in price as stocks are depleted. At the moment the demand is slow. LEAD ACETATE is in more inquiry, and the improvement in value is maintained. LEAD NITRATE.—Unchanged. LITHOPONE is only in limited request, and stocks are small. POTASSIUM CAUSTIC inclines in buyers' favour. POTASSIUM CARBONATE.—No business is reported; price lower. POTASSIUM CHLORATE.—Business is of the hand-to-mouth type, but the price is inclined to harden slightly. POTASSIUM PRUSSATE is distinctly firmer owing to the shortage of the soda product. A further advance is not unlikely. SODIUM ACETATE.—A much better business is reported; price firm and unchanged. SODIUM BICHRIMATE.—Although English makers have reduced their price no improvement in business is apparent. SODIUM NITRITE.—Firmer; secondhands are slowly approaching makers' figures. SODIUM PRUSSATE is again higher in price for spot delivery, and when makers are well sold over the whole year a buoyant market is anticipated. ZINC OXIDE.—Unchanged.

Coal Tar Intermediates

BUSINESS during the past week has been on quiet lines, with but little inquiry about. The export market, however, has been a little more interesting.

ALPHA NAPHTHOL.—A rather better inquiry has been received, and one or two decent-sized orders are in the market. ALPHA NAPHTHYLAMINE continues on quiet lines, but is not without interest.

ANILINE OIL AND SALT continue to pass slowly into consumption at, if anything, rather below makers' figures.

BENZIDINE BASE AND SULPHATE continue to pass regularly into consumption.

BETA NAPHTHOL is steady with a small business passing.

DIMETHYLANILINE is in quiet request, but the price is firm.

DIPHENYLAMINE is firm, and has been inquired for on both home and export account.

"H" ACID is firmer, and a fair inquiry has been received.

NITRO BENZOL has been inquired for on both home and export account, and the price is steady.

PARANITRANILINE is featureless.

"R" ACID has been inquired for, and is without change of price.

Coal Tar Products

THE market, generally, for coal tar products remains unchanged from last week. There is little fresh business doing, but at the same time stocks are not large.

90's BENZOL is selling at 2s. 5d. on rails.

PURE BENZOL is in poor demand, and is quoted at 2s. 11d. on rails in the north, and 3s. 4d. to 3s. 6d. in London.

CREOSOTE OIL is showing signs of further weakness, and is worth about 4½d. to 5d. on rails in the north, and 6d. to 6½d. in the south.

CRESYLIC ACID is also inactive, and is worth 2s. 10d. on rails for the pale quality and 1s. 10d. for 95/97 per cent.

SOLVENT NAPHTHA is also quiet and is worth about 2s. 4d. on rails.

NAPHTHALENE is quiet, with poor inquiry, and prices are from £5 to £8 for crude, with refined at £15 to £17.

PITCH.—The market is more active with a good demand for prompt deliveries. To-day's quotations are 62s. 6d. to 65s. f.o.b. London, 57s. 6d. to 60s. f.o.b. East Coast, 55s. to 57s. 6d. f.o.b. West Coast.

Sulphate of Ammonia

There is no change in the position.

Current Prices

Chemicals

	Per	£	s.	d.		£	s.	d.
Acetic anhydride.....	lb.	0	1	10	to	0	2	0
Acetone oil	ton	87	10	0	to	90	0	0
Acetone, pure.....	ton	82	10	0	to	85	0	0
Acid, Acetic, glacial, 99-100%....	ton	55	0	0	to	60	0	0
Acetic, 80% pure	ton	47	0	0	to	48	0	0
Arsenic	ton	90	0	0	to	95	0	0
Boric, cryst.....	ton	65	0	0	to	68	0	0
Carbolic, cryst. 39-40%.....	lb.	0	0	6½	to	0	0	7
Citric	lb.	0	2	1	to	0	2	2
Formic, 80%	ton	65	0	0	to	67	10	0
Gallic, pure.....	lb.	0	3	10	to	0	4	0
Hydrofluoric	lb.	0	0	8½	to	0	0	9
Lactic, 50 vol.....	ton	40	0	0	to	43	0	0
Lactic, 60 vol.....	ton	43	0	0	to	45	0	0
Nitric, 80 Tw.....	ton	35	0	0	to	36	0	0½
Oxalic	lb.	0	0	8	to	0	0	8
Phosphoric, 1.5	ton	45	0	0	to	47	0	0
Pyrogallie, cryst.....	lb.	0	7	0	to	0	7	3
Salicylic, Technical	lb.	0	0	10½	to	0	1	0
Salicylic, B.P.....	lb.	0	1	4	to	0	1	5
Sulphuric, 92-93%.....	ton	8	0	0	to	8	10	0
Tannic, commercial.....	lb.	0	3	0	to	0	3	6
Tartaric	lb.	0	1	3	to	0	1	4
Alum, lump.....	ton	12	10	0	to	13	0	0
Alum, chrome.....	ton	30	10	0	to	32	0	0
Alumino ferric.....	ton	9	0	0	to	9	10	0
Aluminium, sulphate, 14-16%....	ton	12	0	0	to	13	0	0
Aluminium, sulphate, 17-18%....	ton	13	10	0	to	14	10	0
Ammonia, anhydrous.....	lb.	0	1	8	to	0	1	10
Ammonia, .880.....	ton	35	0	0	to	37	0	0
Ammonia, .920.....	ton	22	0	0	to	24	0	0
Ammonia, carbonate.....	lb.	0	0	4	to	—	—	—
Ammonia, chloride.....	ton	60	0	0	to	65	0	0

	Per	£	s.	d.		£	s.	d.
Ammonia, muriate (galvanisers) ..	ton	35	0	0	to	37	10	0
Ammonia, nitrate	ton	55	0	0	to	60	0	0
Ammonia, phosphate	ton	90	0	0	to	95	0	0
Ammonia, sulphocyanide	lb.	0	3	0	to	—		
Amyl acetate	ton	150	0	0	to	160	0	0
Arsenic, white, powdered	ton	42	0	0	to	44	0	0
Barium, carbonate, 92-94%	ton	12	10	0	to	13	0	0
Barium, Chlorate	lb.	0	0	11	to	0	1	0
Chloride	ton	14	10	0	to	15	10	0
Nitrate	ton	40	0	0	to	42	0	0
Barium Sulphate, blanc fixe, dry ..	ton	24	0	0	to	25	0	0
Sulphate, blanc fixe, pulp	ton	15	0	0	to	16	0	0
Sulphocyanide, 95%	lb.	0	1	6	to	0	1	0
Bleaching powder, 35-37%	ton	14	0	0	to	—		
Borax crystals	ton	31	0	0	to	32	0	0
Calcium acetate, Brown	ton	8	0	0	to	9	0	0
„ „ Grey	ton	10	0	0	to	11	0	0
Calcium Carbide	ton	16	0	0	to	17	0	0
Chloride	ton	7	10	0	to	8	0	0
Carbon bisulphide	ton	60	0	0	to	62	0	0
Casein, technical	ton	75	0	0	to	80	0	0
Cerium oxalate	lb.	0	3	6	to	0	3	9
Chromium acetate	lb.	0	1	1	to	0	1	3
Cobalt acetate	lb.	0	11	0	to	0	11	6
Oxide, black	lb.	0	10	6	to	0	11	0
Copper chloride	lb.	0	1	3	to	0	1	6
Sulphate	ton	28	10	0	to	29	0	0
Cream Tartar, 98-100%	ton	120	0	0	to	125	0	0
Epsom salts (see Magnesium sulphate)								
Formaldehyde, 40% vol	ton	81	0	0	to	82	0	0
Formosul (Rongalite)	lb.	0	3	9	to	0	4	0
Glauber salts, commercial	ton	4	5	0	to	4	10	0
Glycerine, crude	ton	70	0	0	to	72	10	0
Hydrogen peroxide, 12 vols.	gal.	0	2	6	to	0	2	7
Iron perchloride	ton	30	0	0	to	32	0	0
Iron sulphate (Copperas)	ton	4	0	0	to	4	5	0
Lead acetate, white	ton	42	10	0	to	45	0	0
Carbonate (White Lead)	ton	44	0	0	to	47	0	0
Nitrate	ton	48	10	0	to	50	10	0
Litharge	ton	35	10	0	to	36	0	0
Lithopone, 30%	ton	26	0	0	to	27	0	0
Magnesium chloride	ton	10	10	0	to	11	0	0
Carbonate, light	cwt.	2	10	0	to	2	15	0
Sulphate (Epsom salts commercial)	ton	9	10	0	to	10	0	0
Sulphate (Druggists')	ton	15	10	0	to	17	10	0
Manganese, Borate	ton	70	0	0	to	75	0	0
Sulphate	ton	70	0	0	to	75	0	0
Methyl acetone	ton	85	0	0	to	90	0	0
Alcohol, 1% acetone	ton	90	0	0	to	95	0	0
Nickel sulphate, single salt	ton	61	0	0	to	62	0	0
Nickel ammonium sulphate, double salt	ton	62	0	0	to	64	0	0
Potash, Caustic	ton	34	0	0	to	—		
Potassium bichromate	lb.	0	0	7½	to	—		
Carbonate, 90%	ton	31	0	0	to	33	0	0
Chloride 80%	ton	15	0	0	to	20	0	0
Chlorate	lb.	0	0	4½	to	0	0	5
Meta bisulphite, 50-52%	ton	112	0	0	to	120	0	0
Nitrate, refined	ton	45	0	0	to	47	0	0
Permanganate	lb.	0	0	9	to	0	0	10
Prussiate, red	lb.	0	2	4	to	0	2	6
Prussiate, yellow	lb.	0	1	2½	to	0	1	3
Sulphate, 90%	ton	20	0	0	to	22	0	0
Salammoniac, firsts	cwt.	3	5	0	to	—		
Seconds	cwt.	3	0	0	to	—		
Sodium acetate	ton	25	0	0	to	26	0	0
Arsenate, 45%	ton	45	0	0	to	48	0	0
Bicarbonate	ton	10	10	0	to	11	0	0
Bichromate	lb.	0	0	5½	to	—		
Bisulphite, 60-62%	ton	25	0	0	to	27	10	0
Chlorate	lb.	0	0	3½	to	0	0	4
Caustic, 70%	ton	24	0	0	to	24	10	0
Caustic, 76%	ton	25	10	0	to	26	0	0
Hydrosulphite, powder, 85%	lb.	0	2	3	to	0	2	6
Hyposulphite, commercial	ton	13	10	0	to	14	0	0
Nitrite, 96-98%	ton	37	10	0	to	40	0	0
Phosphate, crystal	ton	20	10	0	to	21	0	0
Perborate	lb.	0	1	2	to	0	1	3
Prussiate	lb.	0	0	10	to	0	6	10½
Sulphide, crystals	ton	13	0	0	to	14	0	0
Sulphide, solid, 60-62%	ton	24	10	0	to	25	0	0
Sulphite, cryst.	ton	13	0	0	to	14	0	0
Strontium carbonate	ton	60	0	0	to	65	0	0
Strontium Nitrate	ton	60	0	0	to	62	10	0
Strontium Sulphate, white	ton	7	10	0	to	8	10	0
Sulphur chloride	ton	25	0	0	to	27	10	0
Sulphur, Flowers	ton	13	0	0	to	14	0	0
Roll	ton	13	0	0	to	14	0	0
Tartar emetic	lb.	0	1	6½	to	0	1	7

Tin perchloride, 33%	lb.	0	1	2	to	0	1	4
Tin perchloride, solid	lb.	0	1	5	to	0	1	7
Protochloride (tin crystals)	lb.	0	1	5	to	0	1	6
Zinc chloride, 10% Tw.	ton	21	0	0	to	22	10	0
Chloride, solid, 96-98%	ton	35	0	0	to	40	0	0
Oxide, 99%	ton	38	0	0	to	40	0	0
Dust, 90%	ton	47	10	0	to	50	0	0
Sulphate	ton	18	10	0	to	19	10	0

Coal Tar Intermediates, &c.

	Per	£	s.	d.		£	s.	d.
Alphanaphthol, crude.....	lb.	0	2	3	to	0	2	6
Alphanaphthol, refined.....	lb.	0	2	6	to	0	2	9
Alphanaphthylamine	lb.	0	2	0	to	0	2	3
Aniline oil, drums extra.....	lb.	0	1	0	to	0	1	1
Aniline salts.....	lb.	0	1	1	to	0	1	2
Anthracene, 40-50%.....	unit	0	0	8½	to	0	0	9
Benzaldehyde (free of chlorine) ..	lb.	0	3	9	to	0	4	3
Benzidine, base	lb.	0	5	6	to	0	5	9
Benzidine, sulphate.....	lb.	0	5	6	to	0	5	9
Benzoic acid.....	lb.	0	1	10	to	0	2	0
Benzoate of soda.....	lb.	0	1	9	to	0	1	11
Benzyl chloride, technical.....	lb.	0	2	0	to	0	2	3
Betanaphthol benzoate.....	lb.	0	4	9	to	0	5	0
Betanaphthol	lb.	0	1	9	to	0	2	0
Betanaphthylamine, technical....	lb.	0	6	0	to	0	7	0
Croceine Acid, 100% basis.....	lb.	0	3	6	to	0	3	9
Dichlorobenzol	lb.	0	0	9	to	0	0	10
Diethylaniline	lb.	0	2	9	to	0	3	0
Dinitrobenzol	lb.	0	1	3	to	0	1	4
Dinitrochlorobenzol	lb.	0	0	10	to	0	1	0
Dinitronaphthalene	lb.	0	1	4	to	0	1	5
Dinitrotoluol	lb.	0	1	5	to	0	1	6
Dinitrophenol	lb.	0	2	9	to	0	3	0
Dimethylaniline	lb.	0	2	6	to	0	2	9
Diphenylamine	lb.	0	4	3	to	0	4	6
H-Acid	lb.	0	6	6	to	0	7	0
Metaphenylenediamine	lb.	0	5	6	to	0	5	9
Monochlorobenzol	lb.	0	0	10	to	0	1	0
Metanilic Acid.....	lb.	0	6	0	to	0	6	6
Monosulphonic Acid (2.7).....	lb.	0	5	6	to	0	6	0
Naphthionic acid, crude.....	lb.	0	3	3	to	0	3	6
Naphthionate of Soda.....	lb.	0	3	3	to	0	3	6
Naphthylamin-di-sulphonic-acid ..	lb.	0	4	0	to	0	4	3
Nitronaphthalene	lb.	0	1	4	to	0	1	5
Nitrotoluol	lb.	0	1	0	to	0	1	2
Orthoamidophenol, base.....	lb.	0	10	0	to	0	10	5
Orthodichlorobenzol	lb.	0	1	0	to	0	1	1
Orthotoluidine	lb.	0	1	6	to	0	1	9
Orthonitrotoluol	lb.	0	0	10	to	0	1	0
Para-amidophenol, base	lb.	0	10	0	to	0	10	6
Para-amidophenol, hydrochlor.	lb.	0	10	6	to	0	11	0
Paradichlorobenzol	lb.	0	0	6	to	0	0	7
Paranitraniline	lb.	0	3	6	to	0	3	9
Paranitrophenol	lb.	0	2	3	to	0	2	6
Paranitrotoluol	lb.	0	5	0	to	0	5	3
Paraphenylenediamine, distilled ..	lb.	0	11	0	to	0	11	6
Paratoluidine	lb.	0	7	0	to	0	7	6
Phthalic anhydride.....	lb.	0	2	9	to	0	3	0
Resorcine, technical	lb.	0	5	6	to	0	6	0
Resorcine, pure	lb.	0	7	6	to	0	7	9
Salol	lb.	0	2	3	to	0	2	5
Sulphanilic acid, crude	lb.	0	1	0	to	0	1	1
Tolidine, base.....	lb.	0	6	6	to	0	7	0
Tolidine, mixture.....	lb.	0	2	6	to	0	2	9

Potash

THE lower grades of potash are now very much in favour, partly because they are being offered at extremely low c.i.f. and f.o.r. prices and partly because they are most effective at this season, but the additional charges on these qualities for freight to the farmer's station are proportionately greater than in pre-war times, so that the price to the consumer, in comparison with the low import price, is still much higher than might be expected. In the inland centres there is more demand for sylvinitic 20 per cent. because it is more concentrated than kainit, and consequently does not incur such high freight charges.

The current prices quoted for the various qualities of potash are as follows:

	£	s.	d.
Kainit 14 per cent.	3	12	6 f.o.r. London.
Sylvinitic 20 per cent.	3	12	6 " "
Sylvinitic 30 per cent.	5	12	6 " "
Muriate of potash 50 per cent.	10	10	0 " "
Sulphate of potash 90 per cent.	14	10	0 " "
purity			

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.

GLASGOW, JANUARY 25, 1922.

THE past week proved better than anticipation in general chemicals in the matter of day-to-day business, orders being more plentiful. It is apparent, however, that there is no steady run, and that consumers are still buying for immediate requirements only.

Prices remain steady, with no changes of importance to record.

Continental dealers still offer freely, but quantities are not important and prices incline to harden.

Some difficulty is being experienced in getting goods cleared on arrival, on account of uncertainty as to what goods are liable for Key Industries duty.

Export orders are scarce, and shipping records do not indicate any great activity.

In coal tar products a few enquiries are on the market, but the bulk is not important.

Benzol is more freely offered for forward delivery.

Industrial Chemicals

ACETONE.—Supplies scarce and prices firm at £80 per ton.
ACID ACETIC (GLACIAL).—Small inquiries passing and resellers getting business at £50 per ton. Producers asking £52 per ton.
ACID CARBOLIC.—Ice Crystals, 39/40°. Business slow, 6d. per lb.
ACID BORACIC.—Prices remain firm. Spot lots Crystals, £65; powdered, £67 per ton.
ACID HYDROCHLORIC.—Ordinary commercial, 5s. 6d. per carboy; pure, free from arsenic, 7s. per carboy ex works.
ACID SULPHURIC.—All grades very quiet. B.O.V. £4 10s. to £5 per ton. C.O.V. £5 15s. to £6 per ton. Pure, 168° Tw. free from Arsenic, £8 15s. to £9 10s. in carboys ex works.
ALUM.—Ammonia lump, £16 per ton. Potash, £19 per ton, ex store.
ALUMINIUM CHLORIDE.—Small inquiry for home trade. 1s. 2d. per lb. asked.
ARSENIC.—A few inquiries. Prices steady at £40 per ton for Cornish.
AMMONIA MURIATE (GALVANISERS).—Small business passing. Makers asking £38 per ton, but re-sale parcels still available around £30 per ton.
AMMONIA NITRATE.—Inquiries slow. Germany bordering around £25 per ton. Some parcels recovered from shell available around £22 per ton.
AMMONIA SULPHATE.—Fair business doing, 25½ per cent, £16 6s. 3d. delivered.
AMMONIA LIQUID, 880°.—Very small trade at 3½d. per lb.
BORAX.—Trade quiet. Crystals, £31. Powdered, £32 per ton.
BLEACHING POWDER.—No change and little demand. £14 to £15 per ton for home make.
BARIUM CHLORIDE.—Poor demand. Continent quoting in limited quantity at £16 per ton.
CALCIUM CHLORIDE.—Home makers' price, £7 10s. per ton. Continent offering a little below, but only small inquiry.
CALCIUM CARBIDE.—There are still Continental offers at moderate price for prompt shipment. Spot prices, £20 per ton. Prices firming.
COPPER SULPHATE, 99½ PER CENT.—Small demand and prices easier. £28 to £29 per ton.
GLAUBER SALTS (COMMERCIAL).—No trade, £5 per ton, ex works.
IRON SULPHIDE.—Small demand. £6 per ton, ex works.
LEAD, RED.—Genuine refined, £38 to £40 per ton usual 5 cwt. casks, for approved quantities.
LEAD, WHITE.—£54 per ton in usual casks.
MAGNESIUM CHLORIDE.—Moderate supplies; small request. £8 to £9 per ton.
POTASSIUM BICHROMATE.—Some sales at reduction. 7d. per lb. delivered.
POTASSIUM CARBONATE, 90/92 PER CENT.—£29 per ton. Demand poor.
POTASSIUM CAUSTIC, 88/92 PER CENT.—Rather more inquiry. Price firmer at £33 10s. per ton.

POTASSIUM CHLORATE.—Few inquiries. Spot price, 5½d. per lb.
POTASSIUM NITRATE.—Stocks light and little business passing. £35 per ton.
POTASSIUM YELLOW PRUSSATE.—Sales slow, 1s. 2d. to 1s. 4d. per lb.
POTASSIUM SULPHATE, 90 PER CENT.—Moderate inquiry. £16 per ton, ex ship.
SODIUM CAUSTIC.—70/72 per cent, £23 10s.; 76/77 per cent., £25 10s.; 98/99 per cent., powdered, £29 7s. 6d. Supplies good, but in small request.
SODIUM NITRATE.—Slow market at £14 per ton ex stores.
SODIUM NITRITE.—Retail demand only. £32 per ton, 100 per cent. basis.
SODIUM METALLIC.—Continent offering forward at 9½d. per lb. c.i.f. U.K.
SODIUM SULPHATE.—Moderate inquiry for shipment. £4 to £4 10s. per ton in bulk, f.o.b.
SODIUM SULPHIDE, 60/65 PER CENT.—Some inquiry. Solid in drums, £22 per ton ex works, with re-sale parcels a little under.
SODIUM SULPHITE.—Very slow demand. £14 per ton ex works.
SULPHUR.—Sicilian thirds. Good demand. £4 15s. in bulk, f.o.r., for approved quantity. Government surplus being cleared quickly. Refined block, £12 per ton; roll, £15 per ton; flowers, £15 per ton; all in moderate request for small lots.
ZINC DUST.—Some inquiry for export. 85 per cent quoted £33 15s. c.i.f. U.K.; 80 per cent quoted £30 15s. c.i.f. U.K.

Coal Tar Intermediates and Wood Distillation Products

ALPHA NAPHTHYLAMINE.—Offered at 2s. per lb.
ANILINE OIL AND SALT.—No change and small business passing at 1s. and 1s. 1d. per lb. respectively.
BENZIDINE BASE.—Small inquiry. 8s. 6d. per lb. 100 per cent. basis.
BENZOL.—Rather more offering. Pure, 3s. per gallon. 90's, 2s. 6d. per gallon.
BENZALDEHYDE.—Little inquiry. 2s. 3d. per lb. asked ex works.
BETA NAPHTHOL.—Germany offering at low prices on depreciated currency. Home price, 2s. 3d. per lb.
CHROMOTROPE ACID.—Small inquiry. 13s. per lb. asked 100 per cent. basis.
DIMETHYLANILINE.—Offered at 2s. 8d. per lb. Ton lots, 2s. 7d. per lb.
"H" ACID.—Small inquiry. 7s. per lb. 100 per cent. basis.
MONOCHLOROBENZOL.—Small inquiry for export. Price, £50 per ton.
NAPHTHALENE.—White crystals, £18 per ton; poor demand; Flake, £16 to £17 per ton.
ORTHOCRESOTINIC ACID.—Some small inquiries for export. 2s. per lb. ex works.
PARANITRANILINE.—A few inquiries for export. 3s. 4d. per lb. asked.
"R" SALT.—Some inquiry for export. Around 3s. per lb.
SALICYLIC ACID, B.P.—1s. 3d. per lb. delivered; technical, 10d. per lb.
SULPHANILIC ACID.—1s. 8d. per lb. 100 per cent. basis. Small demand.

Institute of Chemistry

THE following candidates have been successful in the recent examinations and have been duly elected:—

ASSOCIATES.

General Chemistry.—John Harold Crossingham, John Lawrence Hyland, Charles Frederick Randall, B.Sc. (Lond.), Samuel Gordon Stevenson.

Organic Chemistry.—William Ernest Brazier, Malcolm Cuckney, William Derrick.

Chemistry of Foods and Drugs, &c.—Neville Lushanus Wright, D.I.C.

FELLOWS.

Inorganic Chemistry (Section II.) Metallurgy.—Alfred Scholes.

Agricultural Chemistry.—Charles William Brown Arnold, B.Sc. (Lond.).

German Chemical Trade Notes

FROM OUR OWN CORRESPONDENT

Berlin, January 23, 1922

THE market has been featureless. Buying has been entirely of the hand-to-mouth variety, and was incapable of stimulation, despite attractive price offers. The quotations, so far as could be learned, were not substantiated by actual sales in quantity lots, with the exception of caustic soda and soda ash, which met with a well-sustained demand. One lot of 30 tons of copper-sulphate, sold by auction last week, fetched 18.75 marks per kilogram. The latest quotations are (d.=domestic price; e.=export price):—

Acid, Acetic, 80%; supplies are scarce at 19/20 mk. per kilo. d., and 21/22 mk. e.; stocks of glacial, 98/100% are short with a firm tendency at 25/29 mk. per kilo. d., and 31/35 mk. e.; 50% is 11.25 mk. per kilo. d. Acid, Benzoic, white, sublimed, is 45 mk. per kilo. d. Acid, Boracic, pure, 49 mk. per kilo. d., and 51 mk. e. Acid, Oxalic, 98/100% 45 mk. per kilo. d., 50 mk. e. Acid, Sulphuric, 66° Bé. 4.50 mk. per kilo. e., 66° Bé. 6 mk. e. Alum, powdered, 7 mk. per kilo. d., 9 mk. e.; in lumps, 8 mk. per kilo. d., 9.50 mk. e. Chrome, 15%, 18 mk. per kilo. d., 22 mk. e. Alumina Sulphate, 15 mk. per kilo. e. Ammonia Carbonate, powdered, has weakened materially; it is quoted at 14 mk. per kilo. d., 15 marks e.; lumps in barrels of 50 kilos. are occasionally offered at 19 mk. per kilo. d., and 20 mk. e. Barium Chloride, crystallised, is fetching 8 mk. per kilo. d., and 10.50 mk. per kilo. e. Bleaching powder is held at 5.25 mk. per kilo. e., and 4 mk. per kilo. d. Calcium Chloride, 75%, 3 mk. per kilo. e., 90/95%, 3.80 mk. per kilo. d., and 4.40 per kilo. d. Chile-salt-petre, refined, 12.50 mk. per kilo. d. Coppers are quoted at 3 mk. per kilo. e. Copper Sulphate, 98/100% is 17.50 mk. per kilo. d., and 19/21.50 mk. e. Magnesium Chloride, fused, 3.80 mk. per kilo. e. Potash Carbonate 96/98%, 21 mk. per kilo. e., 90/95%, 19 mk., 80/84%, 16 mk. Potash Caustic, 88/92%, 24 mk. per kilo. d., and 24.75 mk. e. Potash Caustic-liquor, 13.50 mk. per kilo. d., 18 mk. e. Potash Chlorate, 17 mk. per kilo. d., 18 mk. e. Potash Metabisulphite—The recent buying movement seems to have come to an end; manufacturers are inclined to sell at 32 mk. per kilo. e. Potash Salt-petre, 14.75 mk. per kilo. d. Salt Cake, 3.20 mk. per kilo. d., 3.40 mk. e. Soda, crystallised, 2.20 mk. per kilo. d., 3 mk. e. Soda Ash, 6.50 mk. per kilo. d., 6/7 mk. e. Soda Caustic, 125/128%, 26 mk. per kilo. d., 24 mk. e. Soda Caustic-liquor is bought at 10 mk. per kilo. Soda Silicate, 1.75 mk. per kilo. d., 2.75 mk. e. Soda Sulphide, 30/32%, 8 mk. per kilo. d., 9.50 mk. e. 60/62%, 18.50 mk. d., 19 mk. e. Sulphur in lumps, is held at 8 mk. per kilo. Zinc Chloride—The export price is 14 mk. per kilo. Zinc Oxide, 90/92%, 12/16 mk. per kilo. d.

Affairs of the British West Africa Trading Co.

MEETINGS of creditors and shareholders under the compulsory winding-up order recently made against the British West Africa Trading Co., Ltd., were held on January 19 at the Holborn Restaurant, London. The company was registered in 1910 to obtain openings for the employment of capital in Nigeria, and subsequently carried on an extensive trade in cocoa, hides, palm oil, palm kernels which were imported from West Africa, and in manufactured goods which were exported to that country. A statement of the company's affairs showed a total deficiency in assets of £769,765. Mr. F. D'Arcy Cooper, the receiver, said he expected that the assets in his hands would realise about £175,000 and a return of 10s. or 11s. 6d. in the £ would be made to the debenture-holders. The return would have been much greater, but for the local law under which local creditors had first been paid in full. The liquidation was left in the department of the Official Receiver.

Ramsey Memorial Fund

At the request of the Ramsay Memorial Committee, a commemorative medal of the late Professor Sir William Ramsay, K.C.B., F.R.S., has been executed by the distinguished French sculptor, M. Louis Bottée. The medals will be struck shortly in London, when it is known approximately how many medals will be required for subscribers to the Ramsay Fund and for friends of Sir William Ramsay. The price of the bronze medal, including postage, will be (a) to subscribers to the Ramsay Fund, 5s.; (b) to all other persons, 7s. 6d. All persons desiring to obtain a medal should send the appropriate remittance by cheque or postal order to Dr. Walter W. Seton, organising secretary, Ramsay Memorial Fund, University College, Gower Street, London, W.C. 1, not later than February 28 next.

Catalogues Received

The Liverpool Chemical Co., of 51, Old Hall Street, Liverpool, in informing us that they have acquired the sole agency for a patent decolorising and deodorising carbon, claim that it is the most active charcoal produced, and as a result of tests they are confident that it will decolorise and deodorise with from 1/20th to 1/10th the quantity of other filtering media.

An extremely attractive brochure entitled the "Key to Successful Farming" has been issued by the British Sulphate of Ammonia Federation, Ltd. In this booklet is given an interesting account of the importance of nitrogen in fertilisers, a statement of the advantages of sulphate of ammonia, and a diagram showing manures which may be mixed without loss, and those whose mixing is attended by loss of nitrogen.

British Drug Houses, Ltd., of 16 to 30, Graham Street, City Road, London, N. 1, send us a copy of the current issue of their catalogue of chemical products, classified under organic and inorganic chemicals; analytical re-agents; solutions employed in volumetric determinations; test solutions and re-agents; microscopic stains (dry); and aniline dyes for technical purposes. The items, which are in alphabetical order, occupy no fewer than 88 octavo pages.

H. K. Lewis & Co., Ltd., 136, Gower Street, London, have just issued a new list of "College Textbooks and Works of Reference in Science and Technology." The titles are arranged alphabetically under authors' names, and are classified under eighteen subjects, some of which, such as chemistry, engineering, &c., are again divided. The subjects are arranged alphabetically, while a contents list on the first page makes reference to any subject quick and easy. The list will be sent post free to any address on application.

We have received from Gent & Co., Ltd., of 25, Victoria Street, London, S.W. 1, a copy of their Folder No. 57, describing a complete range of motor syrens as used for time signals, fire alarm, and other factory purposes. These syrens consist of an enclosed motor fitted with a syren consisting of aluminium rotors and cast iron stators, so arranged that the air is driven by centrifugal force through openings in the periphery of the stator. The rotating member automatically opens and closes the apertures, thereby producing the requisite sound wave.

A twelve-page booklet describing the Knowles patent plant for producing electrolytic oxygen and hydrogen reaches us from the International Electrolytic Plant Co., Ltd., of the City Electricity Works, New Crane Street, Chester. In the "Knowles" patent furnace the hydrogen or oxygen is passed through the furnace over a heated catalyst, and the impurity is ignited to form water vapour. The furnace is designed on a reverse current system so that the hot gas leaving it heats the cold incoming gas. Provided that none but thoroughly washed gas is passed through it, it is claimed that the catalyst is practically everlasting. The pamphlet contains an illustration of the "Knowles" patent multipolar cell, and graphs relating to output and flexibility.

Centrifugal Separators, Ltd., of Iddesleigh House, Caxton Street, Westminster, London, S.W. 1, send us a copy of their new general catalogue describing the "Gee" centrifugal separator. A sectional illustration of the separator shows that the machine is proportioned quite differently from the ordinary type of hydro-extractor in that the depth of the drum is one-and-a-half times the diameter. One of the most obvious advantages claimed by the makers for this alteration is that the capacity of the machine in terms of recovered solids per charge is increased to from three to four times that of the hydro-extractor. The company maintain an experimental and demonstration works at Queen's Road, Peckham, London, S.E. 15, where prospective users are invited to inspect the machines in operation.

A catalogue describing the "Hume" concrete pipe has recently been issued by the Hume Pipe and Concrete Construction Co., Ltd., of 7c, Lower Belgrave Street, Westminster, London, S.W. 1. This pipe is the product of a machine for the centrifugal manufacture of concrete articles, the invention of Hume Brothers, of Adelaide, Australia. Concrete pipes made by this method are claimed to be superior to those made by ramming or jiggling processes, as practically all the air and water originally contained in the concrete is squeezed to the inner surface of the pipe by centrifugal force. The catalogue states further that the Stanton Ironworks have secured the right to operate the process in Great Britain and will shortly be in a position to deal with 1,000 tons of pipes weekly.

Company News

ALLEN-LIVERSIDGE, LTD.—A final dividend is announced at the rate of 10 per cent. per annum (less tax) for the six months ended October 31 last, making 10 per cent. for the year.

SOCIÉTÉ GÉNÉRALE DES HUILES DE PÉTROLE.—It is announced that the capital is to be increased from 100,000,000 francs to 227,000,000 francs. Of this increase, 120,000,000 francs is being issued this week at par, a large proportion being guaranteed by the Anglo-Persian Oil Co., Ltd.

TYEE COPPER CO.—The board announce that all the assets of the company in British Columbia at present realisable have been sold and the proceeds received. An extraordinary general meeting of the company is called for February 1 for the purpose of passing an extraordinary resolution to wind up the company voluntarily. It is anticipated that the shareholders should receive a distribution equal to 5s. in the £ on the nominal amount of their shares, and it is hoped that such distribution will be made at an early date.

BRITISH DYESTUFFS CORPORATION, LTD.—The directors announce that some time must elapse before the claims on the Revenue authorities for a refund of Excess Profits Duty can be settled, and until this has been done the accounts for the company's year ended October 31 last cannot be completed. They regret that owing to depression in the textile and other colour-consuming trades and the heavy fall in stock values, the trading results are such as do not permit of any payment in respect of the preference dividend for this period.

LEVER BROTHERS, LTD.—A Stock Exchange announcement states that dealings in 2,600 7 per cent. preference shares of £1 each, fully paid, Nos. 23,567,012 to 23,569,611; and 1,280 8 per cent. "A" preference shares of £1 each, fully paid, Nos. 15,469,363 to 15,470,642, have been specially allowed by the Committee under Rule 148a. These securities will rank *pari passu* with those in which special settling days have already been appointed, as soon as they are identical and the certificates are ready for distribution, and with those for which an official quotation has already been granted as soon as they are identical and are officially quoted.

NOBEL INDUSTRIES, LTD.—Dealings in the following securities have been specially allowed by the Stock Exchange Committee under Rule 148a. These securities will rank *pari passu* with those in which special settling days have already been appointed, as soon as they are identical and the certificates are ready for distribution, and with those for which an official quotation has already been granted as soon as they are identical and officially quoted: 1,240 ordinary shares of £1 each fully paid, Nos. 7,954,946 to 7,955,886 and 7,995,775 to 7,996,073; 1,706 6 per cent. cumulative preference shares of £1 each, fully paid. Nos. 5,993,192 to 5,993,574 and 6,077,564 to 6,078,886; and eleven deferred shares of £1 each, fully paid, Nos. 1,444,942 to 1,444,952.

ANGLO-PERSIAN OIL CO., LTD.—Applications have been invited for 2,000,000 8 per cent. cumulative first preference shares of £1 each at £1 1s. per share, and 600,000 ordinary shares of £1 each at £3 5s. per share. A full half-year's dividend on the preference shares now offered will be paid on July 31 in respect of the half-year ending March 31, 1922. The dividend on the ordinary shares has hitherto been paid on January 31 in respect of the financial year terminating on the previous March 31. The ordinary shares now offered will rank for dividend from January 1, 1922, and will therefore receive one-quarter of the rate of dividend declared on the ordinary shares in respect of the year terminating on March 31, 1922. The issue was made mainly for the purpose of providing funds necessary for the various developments now in progress and projected by the company and its allied concerns, including the testing and development of new oilfields, the extension of existing refineries, and the erection of new ones to deal with the increased output. The issue was over-subscribed before the prospectus was issued, and the list closed on Monday morning.

Soap Films and Molecular Forces

THE lecture on "Soap Films and Molecular Forces" which Sir James Dewar gave at the Royal Institution on January 20 presented a continuation of the studies in capillarity which formed the subject of lectures he delivered in 1916 and subsequent years.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REF. No.
Aden ..	Perfumery	85
Denmark ..	Chemicals; edible oils	96
Switzerland ..	Soap and perfumery	105
San Francisco	Casein	111
"	Caustic soda, soda ash, paints, sulphate of ammonia, talc, &c.	115
Panama ..	Soap	121

Tariff Changes

FEDERATED MALAY STATES.—Revised rates of export duties leviable on any cultivated rubber, with effect from November 24 last, were published in the Board of Trade Journal (January 12, p. 45).

HUNGARY.—A list of goods in respect of which a surtax of 7,900 per cent. is now leviable includes, *inter alia*, paraffin, oleic acid, axle grease, olive oil, sesame oil, peanut oil, heavy oils except prepared lubricating oils and residues from the distillation of mineral oils, candles, common soap, and matches.

German Dyes in China

IN view of the recent reports regarding the activities of German dye-manufacturers, in China and other far Eastern markets, the illustrations appended are of considerable interest as illustrating the thoroughness of German merchandising methods. The illustrations are taken from a collection



of nine designs similar in character, which have been issued by the firm of Leopold Cassella & Co., Gmb. H., of Frankfurt-on-Main, Germany, for use as trade marks on their coal-tar dyes and mineral salts. An application has been made by the firm for the registration of these trade marks in this country.

The Oil Palm in Liberia

IT is estimated that there are about 50,000,000 oil-palms in Liberia, but there is very little export trade in palm oil or palm kernels; in fact, not one-twentieth of what it might be. There are several reasons for this, of which the most important are lack of transport facilities and the law, which is still in force, forbidding white men to trade by barter with the natives in the interior. This law was really aimed at the Germans, who, before the war, controlled nearly all the interior trade, chiefly in palm kernels and palm oil; but since it applies to all white men it effectually blocks trade and development. It is hoped that the American loan of 5,000,000 dollars will considerably improve matters by providing better transport, establishing trading stations, and by encouraging the natives to collect the palm produce, and to undertake, on a much larger scale, the manufacture of palm oil by improved methods. There are also many other valuable products in which an increasing trade could be fostered, *e.g.*, shea butter, kola nuts, piassava and drug plants. The natives are said to be anxious that the Americans should come and help them to develop trade and industry in these lines.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette

Bankruptcy Information

NORMAN, John Thomas, 23, Leadenhall Street, London, consulting chemist. Receiving order, January 18. Creditor's petition. First meeting, January 31, 11 a.m. and public examination, March 24, 11 a.m. Bankruptcy Buildings, Carey Street, London, W.C. 2.

WALKER, William Brocklebank, carrying on business as a chemical merchant, at 40, Brazennose Street, Manchester, chemical salesman. First meeting, February 1, 3.30 p.m. Official Receiver's Offices, Byrom Street, Manchester. Public examination, February 24, 10 a.m., Court House, Quay Street, Manchester.

Notices of Intended Dividends

JOHNSON, Bernard Charles, and TOWNSEND, Benjamin John, trading as the Trent Soap and Chemical Co., Bank Square, Burton-on-Trent, Staffordshire, chemical manufacturers. Last day for receiving proofs, February 12. Trustee, R. Rhodes, 18, Low Pavement, Nottingham.

KEATS, Philip Phineas, 167, Mary Street, Balsall Heath, Birmingham, chemist. Last day for receiving proofs, February 4. Trustee, J. D. Kerr, 5, Waterloo Street, Birmingham.

Company Winding Up Voluntarily

CHLORIDE SYNDICATE, LTD. D. Anderson, 1, London Wall Buildings, E.C.2, appointed liquidator. Meeting of creditors at London Wall Buildings, London, January 30 at 11 a.m.

Liquidator's Notice

BLANKLEYS (CHEMISTS), LTD., 115, High Street, Brierley Hill. (In voluntary liquidation.) Particulars of claims to G. R. Griffin, 43, Cannon Street, Birmingham, a joint liquidator of the company.

Edinburgh Gazette

COWAN & HETHERINGTON, chemical manufacturers, 2, Inglefield Street, Govanhill, Glasgow. Firm dissolved November 30, 1921, by mutual consent by the retirement of Charles Cowan. The business will be carried on by Andrew Hetherington.

County Court Judgments

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.]

DINGLE, F., 7, Wells Street, Torrington, chemist. £18 4s. 6d. November 18.

HALEY, H. W., Greenside House, Huddersfield, dyeware merchant. £15 10s. 6d. November 16.

MIDDLETON, John George, and wife, 6, Arthur Street, Coatham, Redcar, chemist. £23 11s. 4d. November 17.

MURRAY, John William E., 9, Fenwick Terrace, North Shields, paint and varnish manufacturer. £22 2s. 6d. November 14.

STEVEN, George (trading as G. STEVEN & CO.), Cornbrook Works, Chorlton Road, Manchester, manufacturing chemist. £11 0s. 1d. November 14.

Receiverships

ABBEY CHEMICAL CO., LTD. (old company). J. Fabian, of 27, Clement Lane, E.C., ceased to act as receiver or manager on January 10, 1922.

BALTIC WHARVES CHEMICALS, LTD. H. Musgrave, of 36, Mark Lane, E.C., was appointed as receiver on January 17, 1922, under powers contained in debenture dated June 28, 1921.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, created after July 1, 1908, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges which would, if created after July 1, 1908, require registration. The following Mortgages and Charges have been so registered. In each case the total debt, as specified, in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

BELL (JOHN) & CROYDEN, LTD., London, W., chemical manufacturers. Registered January 11, charge under Land Transfer Acts collateral to mortgage, registered October 24, 1921, to London County Westminster & Parr's Bank, Ltd., securing all moneys due or to become due to the bank; charged on 6, Giltspur Street, E.C.

BRITISH CELLULOSE AND CHEMICAL MANUFACTURING CO., LTD. (late BRITISH CELLULOSE AND CHEMICAL MANUFACTURING (PARENT) CO., LTD.), London, S.W. Registered January 9, £150,000 prior lien debentures, to Lloyds Bank, Ltd.; general charge. *Nil. December 23, 1920.

BURNARD & ALGER, LTD., Plymouth, chemical manufacturers, &c. Registered January 10, mortgage to Lloyds Bank, Ltd., securing all moneys due or to become due to the bank; charged on land, premises, &c., at Cattedown, Plymouth, also general charge. *Nil. May 18, 1921.

CARRERAS (A. & E.), LTD., London, E.C., perfumers, &c. Registered January 4, transfer of mortgage and further charge securing £11,000, including £10,000 transferred to Economic Insurance Co., Ltd., Furness House, Billiter Street, E.C.; charged on Palladium Opera House, King's Road, Brighton, and flat over entrance thereto. *£17,850. August 16, 1921.

COLEY & WILBRAHAM, LTD., London, E.C., chemists, &c. Registered January 11, £1,000 debentures; general charge. *— December 30, 1921.

CUMBERLAND COAL POWER & CHEMICALS, LTD., London, S.W.—Registered January 6, £7,000 8 per cent. six months secured notes, part of £200,000; charged on benefits, under certain agreement and 4,096 shares as and when acquired by company thereunder, also general charge. *Nil. December 31, 1920.

LOCKWOOD (DONALD) & CO., LTD., London, E., chemists. Registered January 10, £2,000 debentures; general charge. *Nil. November 27, 1921.

SOUTH AFRICAN CARBIDE & BY-PRODUCTS CO., LTD., London, E.C. Registered January 10, £75,000 debenture stock, secured by Trust Deed dated December 29, 1921; charged on company's immovable property in Natal, also general charge. *Nil. January 13, 1921.

STE. MADELEINE SUGAR CO., LTD., London, E.C. Registered January 10, Trust deed dated December 22, 1921 (supplemental to trust deed registered August 11, 1921, securing £200,000), modifying clause 7 of Trust Deed registered August 11, 1921, so as to release from the Trust Deed growing crops whether on the company's lands or not. *Nil. December 31, 1920.

TAYLORS' DRUG CO., LTD., Leeds. Registered January 4, £700 mortgage, to D. E. Speight, Leeds, solicitor; charged on 18, Bridge Street, Ramsbottom. Registered January 12, £1,000 mortgage, to Mrs. L. Macgregor, 2, Duke Street, Manchester Square, London, and others; charged on 10, Albert Road, Widnes; also registered January 12, £500 mortgage, to F. Speight, The Ellers, Park Lane, Roundhay, Leeds, contractor; charged on 19, Commercial Street, Rothwell, with outbuildings, &c. *£66,168 16s. 2d. November 28, 1921.

WHARRAM (W. A.), LTD., Leeds, chemists. Registered January 13, £608 mortgage, to Leeds Permanent Benefit Building Society; charged on 1, Pleasant View, and 63, Domestic Street, Holbeck. *£4,474 12s. 8d. December 31, 1920.

Satisfactions

FLETCHER (MARK) & SONS, LTD., Whitefield, bleachers, &c. Satisfaction registered January 7, £13,200, balance of amount outstanding July 1, 1908.

SOUTH AFRICAN CARBIDE & BY-PRODUCTS CO., LTD., London, E.C. Satisfaction registered January 18, £5,000, registered December 5, 1921.

TRADE GUIDE

CHEMICAL AGE

Acids

SULPHURIC
MURIATIC
DIPPING
BATTERY
NITRIC

OLEUM
(all Strengths)
and
SALTCAKE

SPENCER CHAPMAN & MESSEL, Ltd.
56, Mark Lane, E.C.3.

Acid Resisting Metals

MONEL Succeeds where other Metals fail.
Acid-resisting-Incorrodible Bars, Rods, Sheets, Wire Castings, Forgings.

G&J.WEIR LTD MONEL CATHCART, DEPT. GLASGOW.

Analytical Reagents



Research Chemicals
THE BRITISH DRUG HOUSES, LTD.,
Graham St., City Rd.,
LONDON, N.

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